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Queensland Geological Survey.

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Mesozoic Insects of Queensland.

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By B. DUNSTAN.

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Mesozoic Insects of Queensland

Part 1.—Introduction and Coleoptera

INTRODUCTION

Previous Geological Work.—The discovery of five elytra and some thoracic and abdominal fragments of fossil insects at Denmark Hill, Ipswich, in association with abundant fossil flora, was made in 1890 by Mr. T. H. Simmonds, and this was followed by the publication of some notes and drawings by Etheridge and Olliff* in 1908. One of the specimens was named *Mesostigmodera typica,* and, subsequently, four other specimens were named by Handlirsch† after seeing the drawings published by Etheridge and Olliff, his species being *Etheridgea australis, Ademosyne major, Ademosyne minor,* and *Pseudorhynchopora Olliffi.* The original drawings of the four specimens, however, were not well executed, and Handlirsch's descriptions, therefore, were based on somewhat unreliable data, while his own reproductions of the original drawings accentuated the errors by being indifferently drawn.

In 1899, nine years after Mr. Simmonds's operations, the writer undertook the further exploitation of the Denmark Hill beds specially for flora, and acting on some suggestions by Mr. Simmonds rediscovered the bed which now we know to be the bed from which he obtained his insect specimens, but in addition also located another one six inches thick a few feet higher up. It is from this small bed that nearly all the specimens recently found have been obtained. The details of the strata were then worked out, and the information published in a Bulletin in 1916,‡ which may be consulted for further information. Dr. Tillyard undertook their description, and seven new species were recorded, Handlirsch's *Pseudorhynchopora Olliffi* being renamed *Ademosyne Olliffi.*

Quarrying Operations.—The position of the beds containing the fossil insects and the associated fossil flora is described and illustrated by a small scale plan and section, together with

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* Mesozoic and Tertiary Insects of New South Wales (and Queensland). Mem. Geol. Surv. N.S.W. Palæontology No. 7, pp. 9-12, with 2 plates, 4to. Sydney. By Authority, 1890.

† Die Fossilen Insekten and die Phylogenie der regenten Formen von Anton Handlirsch. Leipzig, 1908, 4to, p. 1430, with Atlas of 91 plates. (Engelmann.)

‡ Mesozoic and Tertiary Insects of Queensland and New South Wales. R. J. Tillyard and B. Dunstan. Queensland Geol. Surv. Pub. 253. Brisbane, by Auth. 1916, p. 47; 9 plates.

two whole plate photographs in the publication referred to above, and at the completion of the recent quarry work, steel pegs were driven at intervals into the pavement of the six-inch bed, and a plan made of their positions, survey connections being established with marked trees in the vicinity. The precipitous quarry face formed during the operations is on a Public Reserve and had to be demolished, and the floor is now covered by debris, but the positions of the pegs can easily be ascertained from the survey plan attached. *See* Plan (No. 1) of Quarry opposite.

A careful record has been made of the position of every square foot of shale removed, and the boxes in which the material is packed are all numbered, the object of the record being to determine whether rich and poor patches exist in the bed, and if so, whether their extension away from the quarry can be followed. The plan of these operations has not been reproduced because up to the present no reliable deductions can be made, but more material has to be operated upon and no doubt the trend of the rich portion of the bed will reveal itself later on, if such exists.

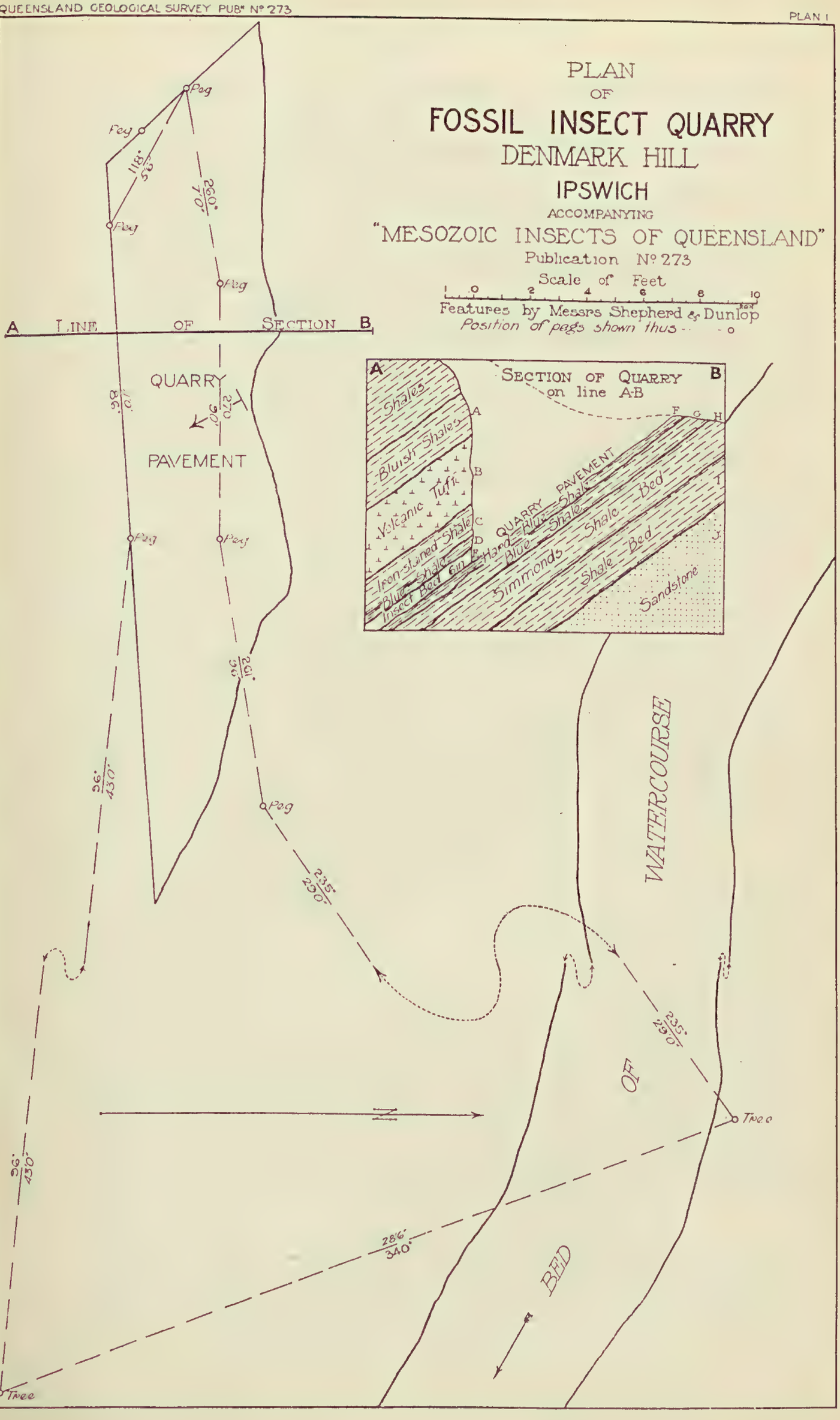
The six-inch bed of fine clay shale is perfectly adapted to the preservation of the delicate insect remains. Where the surface weathering of the bed has not been too severe, or where there are no disturbing cleavages across the bedding planes to allow percolation of water and deposition of clay between the fine laminæ of the shales, the material is very clean and may be split very finely and evenly with thin wedges and a light hammer. When the bed is deep-seated, *i.e.*, with a covering of other beds several feet thick, the shales do not so readily split and are inclined to break across the bedding planes. In consequence of this, the deeper deposits yield only a few fossil insects, and it is to the lateral extension, therefore, that attention should be given in future field operations. In one direction the sides of the quarry hill should be prospected, while in the opposite direction, beyond the adjacent alluvial area, the group of beds to which the six-inch band belongs is exposed on the slope of a hill and should also be examined.* (*See* Plan 2 facing page 8.) If the insects are not found in a preliminary search their absence is not to be assumed, experience showing that the finding of a productive bed may take some time, even when its existence is known. The genus *Ademosyne* is looked upon as the fossil "indicator," because once its occurrence has been established the bed in which it is found should be further tested for other forms.

* Recently examined and found to be fossiliferous, one specimen, *Ademosyne major*, being discovered. B. D.

PLAN
OF
FOSSIL INSECT QUARRY
DENMARK HILL
IPSWICH
ACCOMPANYING
"MESOZOIC INSECTS OF QUEENSLAND"
Publication Nº 273

Scale of Feet
1 0 2 4 6 8 10

Features by Messrs Shepherd & Dunlop
Position of pegs shown thus - - o



Once the position of a fossiliferous bed is established it may be found convenient to take out all the material, pack it into boxes, and operate on it under more favourable laboratory conditions.

Destruction of Insect Life.—The cause of the destruction of the insects has been a subject of much consideration, and there appears to be no geological parallel to the phenomenon, but an examination one summer evening of the hot springs at Einasleigh, towards Georgetown in Northern Queensland, gave the impression that the insect destruction at Denmark Hill must have taken place in the vicinity of hot springs. At these springs the edges of the pools were seen to be lined with myriads of wings and elytra, from which the fleshy portions were evidently removed by the hot bubbling water, while insect fragments floated about on the pools and then disappeared down the stream.

That the "boiling down" process was in operation in a hot spring at Denmark Hill is very evident from the character of the remains. Only a few specimens have been found with the elytra attached to the bodies, and invariably all appendages are missing, the legs and antennæ not even being recognisable in their disintegration and in their resemblance to, and admixture with, small twigs and plant remains. Thoraces and abdomina have been found, but mostly in such fragmentary pieces that they are useless for identification purposes. Wings, tegmina, and elytra evidently accumulated on the surface of the hot water pools or stream and ultimately drifted away to the deposits of fine silt in which they afterwards became embedded.

The seasonal conditions under which the small six-inch silt band was built up suggests that the occurrence took place during a Triassic summer. Although only insects capable of flight were destroyed, others must have existed at the time, but no trace can be found of their remains. Aquatic beetles were the predominating forms, and next to these cockroaches were the most abundant, all being destroyed in their flight across the heated waters. Where the fine mud was being deposited, or in its vicinity, numerous water fleas must have been present, as impressions of the shell-like carapaces of the little Ostracod, *Estheria mangaliensis*, are quite common with the insect fragments.

Plant Destruction and Fossilization.—That summer time was the season in which the fossil band was formed may be gauged by the fact that bush fires must have been prevailing

at the time, and fragments of charcoal, quite fresh and apparently unaltered, are to be seen bedded with the fossil insects and with a variety of fossil leaves, seeds, and fruits.

Some investigations carried out about Brisbane, where there is an extension of the Ipswich beds, indicates that large quantities of tuff were deposited at that time under violent volcanic conditions, and caused the destruction of all the pine and other trees then growing, some of which were crushed and entombed by the volcanic dust, others being partly reduced to charcoal or entirely burnt. The timber entirely enveloped by the tuff during the eruption has been preserved, and soluble silica, perhaps in the presence of heated water and derived from the volcanic material, has replaced the organic compounds forming the cells of the wood. The portions of the timber burnt have remained as charcoal, while the timber partly decayed and lying on the ground has not been silicified, but has become fossilized in a friable condition. These conditions prevail to a limited extent at Ipswich where small bands of volcanic tuffs are to be observed associated with the fossiliferous shales.

Another phenomenal occurrence at Denmark Hill is the siliceous replacement of tissue in the cell structure of the fossil fern *Thinnfeldia,* immediately above the fossil bed, an effect probably resulting from the heated water conditions. It is also remarkable that no other fossil fern amongst the many associated with *Thinnfeldia* has been observed silicified in this way.

Associated Fossil Flora.—The Ipswich Fossil Flora has been worked out by Dr. Walkom and the descriptions have been published in his "Mesozoic Floras of Queensland."*

The Denmark Hill plant fossils, of which a list was given in "Mesozoic Insects of Queensland," Pub. 253† have recently been examined more in detail, and the following is a list of the species obtained from the six-inch bed found while searching for the insects. The number of specimens found have been recorded, and the approximate percentages given below show the great preponderance of *Thinnfeldia* above all other plant species:—

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* Mesozoic Floras of Queensland, Part I., A. B. Walkom, B.Sc., Queensland Geol. Surv. Pubs. 252, 257, and 259. Brisbane. By Auth. 1915 and 1917. 24 plates.

† *Ibid.*

FOSSIL FLORA FROM INSECT BED.

Thinnfeldia odontopteroides, *Morris*	60%
Thinnfeldia Feistmanteli, *Johnston* Thinnfeldia lancifolia, *Morris* Thinnfeldia acuta, *Walkom*	10%
Stenopteris elongata, *Carruthers*	5%
Sphenopteris superba, *Shirley*	4%
Gymnospermous seeds, (Beania, &c.)	4%
Cladophlebis australis, *Morris* Cladophlebis Roylei, *Arber*	4%
Tæniopteris Tenison-Woodsi, *Eth. fil.*	2%
Ginkgo antartica, *Saporta* Ginkgo digitata, *Brongniart*	2%
Stachyopitys annularioides, *Shirley* Stachyopitys Simmondsi, *Shirley*	2%
Dictyophyllum rugosum, *L. & H.*	1%
Baiera Simmondsi, *Shirley* Baiera bidens, *Tenison-Woods* Pterophyllum multilineatum, *Shirley* Pterophyllum *cf* contiguum Calamostachys australis, *Shirley* Pseudoctenis sp.	(aggregate) 4%

FOSSIL FAUNA.

Estheria mangaliensis, *Jones*	2%
	100%

LABORATORY WORK.—In searching for fossil insects experience has shown that the failure to find specimens may be due simply to the absence of colour contrasts between the matrix and the impressions of the insects, the fine membranous wings specially being difficult to identify. Casual observation may reveal their presence, but most of the Ipswich specimens, some perfectly preserved, have been found only by close examination with a pocket lens of two-inch focus. Closer inspection requires a lens of one-inch focus, while for finer structures the use of a microscope is often an advantage.

Early morning or afternoon sunlight, in being at a low angle, is the best natural light in which to work, the shadows of the fossil impressions then being identified without unduly straining the eyes. A strong artificial light, such as a petrol lamp, set at an oblique angle and shaded, is better to work with than a dull natural light, but the light must be a bright one, otherwise the chances of missing specimens are much greater.

The wedges best adapted for delicately splitting the shale are about half an inch wide and an inch long, sections of a softened razor blade or table knife being very suitable, while for large blocks a small gad is a convenient tool. The hammer for splitting the large blocks should be about 1 lb. in weight, with a sharp edge at right angles to the handle, and for splitting the small pieces with the wedges, one of about 2 oz. with a rather short handle is found to be very convenient.

Cardboard trays with covers, 1½ inches square and ¼-inch deep, are sufficiently large for most of the specimens, the latter being cemented on to the bottom of the tray with a liquid glue, or on to square pieces of cardboard fitting the trays if their removal for microscopic examinations is required afterwards. Fastening the specimens with glue is desirable as delicate impressions are not injured by shaking, and no wrapping is required. Ipswich shale is very easily trimmed to shape with a sharp penknife, and specimens can be cut down to fit the trays and should be scraped sufficiently thin to prevent abrasion of the impression by the cover. If the insects in the trays are packed away in boxes they should be numbered both on the cover and on the bottom of the trays, to prevent confusion in working and labelling, and if packed away on their ends, which is convenient, they should also be numbered on the top edges.

The shale seldom yields a fossil impression without some portion of the counterpart remaining adhered to it, and this broken piece has to be removed, and then fastened by a liquid cement to the portion to which it belongs, two specimens thus being recovered—the obverse and reverse. Cutting away the attached portions of the counterpart is usually a very delicate operation, particularly if it is a membranous wing, and a very small, thin knifeblade or lancet is required for the operation. Small sections of the adhering piece, perhaps no larger than one-eighth of an inch square, are removed by cross-cutting, and each section is cemented into its proper place on the counterpart before the next piece is removed, otherwise there is the certainty of irregularity in the outline of the counterpart impression or of misplacement. The type specimen of *Mesogereon superba* used by Dr. Tillyard in illustrating that species had a long, thin shell-like piece covering the impression, which had to be cut away in small pieces, and the counterpart built up piece by piece. This counterpart (or reverse part) is now almost as perfect as the obverse specimen used as the type.

The laboratory work is conducted on a low table, and an apron is necessary in case a valuable chip flies off when splitting,

while immediately below the table the floor should be kept free from accumulated debris to further minimise the search after a missing fragment.

The upper portion of the six-inch band is more prolific than the lower, simply because the upper portion is easily split up into layers and has not the brittleness of the lower part. A piece of the shale one inch thick is made up of at least fifty laminæ, but 3/16-inch is about the average thickness of the pieces after being split, their liability to cross-fracture not allowing fine splitting. Consequently, the number of recovered fossils would represent about one-tenth of the number originally entombed.

Taking into consideration the thickness of the band, the area of the band so far revealed, the average number of fossils obtained from each square foot, and the estimated percentage not recovered, the number of insects entombed in about 15 square yards must have been several thousands. From this small area the species recovered number about 133, including those previously described, those herein described, and those about to be described by Dr. Tillyard in Part 2, and after making allowance for the probability of a number being male and female of the one species there must be at least 120 new winged insects revealed up to the present time.

No practical scheme has been devised to separate the laminæ into thinner portions and recover the insects remaining in the discarded shale. About 50 per cent. of the material is discarded in the splitting and sorting, while the other 50 per cent., consisting of very small pieces showing no impressions on their surfaces, is repacked in the boxes for finer splitting at some future time.

Geological Horizon.—In the examination of the Ipswich Coal Measures the palæontological work of Dr. Walkom on the fossil flora and that of Dr. Tillyard on the fossil insects have been of very great assistance towards establishing their geological horizon. The examination of the Coleoptera, however, has not been attended with such good results, as the observed characters of the fossilized portions of these insects, *i.e.*, the elytra, could not be compared with similar parts of beetles of the present day, for the reason that most of the families and genera of living forms are classified on structures which in fossil beetles are not usually preserved, or if preserved are in such a fragmentary condition as to be almost useless for correlation purposes.

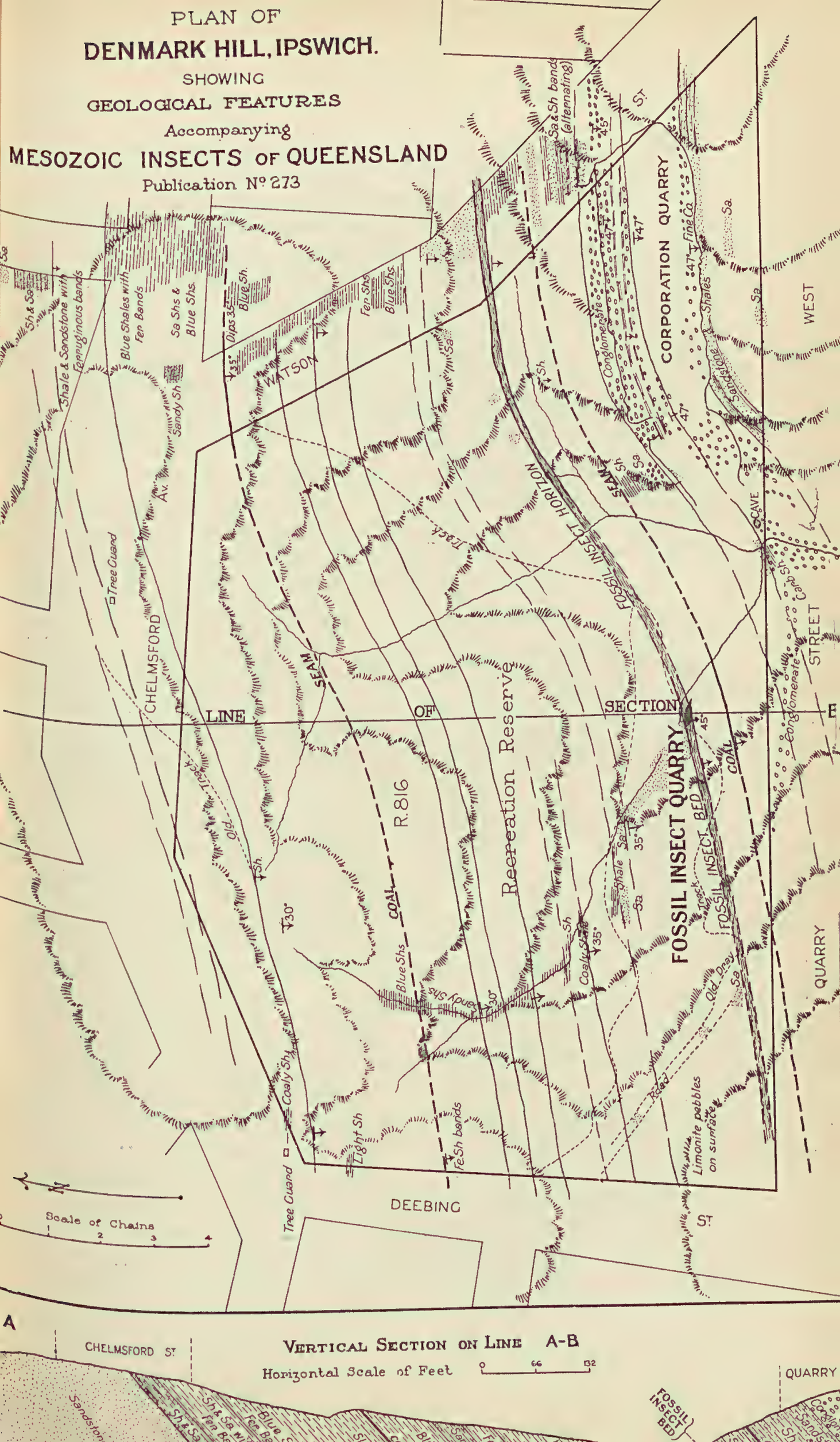
A decided impression exists, as the result of numerous discussions and observations, that the horizon of the Ipswich beds is probably Upper Triassic, and Dr. Tillyard in his papers is very emphatic on the point, basing his opinion on palæo-entomological evidence. Nevertheless, it would not be wise to permanently adopt this horizon for the beds until more is known about the formations associated with them. The Mesozoic marine beds of Western Queensland and those of the Maryborough District, have yielded a great number and variety of undescribed marine shells which, with those already described, require to be examined by a specialist before that series is decided to be actually Cretaceous, the system now assigned to them, or whether portion only belongs to this system.

After the examination of the marine fauna the position of the thick Walloon Series, at present assigned to the diminutive Jurassic, can be considered, and as it is everywhere conformable with the marine beds above, what affects one also has some bearing on the other. If the evidence warrants their being placed lower down in the geological scale, the horizon of the Ipswich beds, which are conformable with the Walloon, will also require readjustment.

The first point to settle is the evidence on the marine life, and afterwards that of the flora and insects, so that before the age of the Ipswich Series is fixed permanently more work requires to be accomplished. In the meantime, however, we will retain the Ipswich Series, and their contained insect-bearing beds, as a formation in the Upper (?) Triassic System.

Coleoptera Classification.—The lack of evidence on which to compare fossils with recent forms of Coleoptera, referred to above, presents to a great extent researches being instituted on the phylogenic changes which these insects have undergone in geologic times. Scudder,* in discussing this defect in recent classification methods, stated that "It must be confessed, however, that amongst the fossils the Coleoptera are far less apt to have those characteristics of their structure which are seized upon for generic disassociation sufficiently preserved to warrant great certainty or insure exactitude, and that those orders which display wing neuration afford far better means of judgment, on account of the commonly better preserved remains of just those parts which are largely relied upon for generic discrimination."

* Tertiary Rhynchophorous Coleoptera. S. H. Scudder. U.S. Geol. Surv. Mem. XXI., 1893, page 6.


PLAN OF
DENMARK HILL, IPSWICH.
SHOWING
GEOLOGICAL FEATURES
Accompanying
MESOZOIC INSECTS of QUEENSLAND
Publication Nº 273
CHELMSFORD
WATSON
CORPORATION QUARRY
WEST
STREET
QUARRY
DEEBING
LINE OF SECTION
SEAM
INSECT HORIZON
FOSSIL
Recreation Reserve
R.816
FOSSIL INSECT QUARRY
FOSSIL INSECT BED
COAL
Old Track
Old Dray Road
Limonite pebbles on surface
Tree Guard
Light Sh
Coaly Sh
Blue Shs
Sandy Shs
Fer Shs
Blue Shs
Sa Shs & Blue Shs
Blue Shales with Fer Bands
Shale & Sandstone with ferruginous bands
Sa & Sh bands (alternating)
Conglomerate
Fine Ca.
Shales
Sandstone
Cave
Scale of Chains
1 2 3 4
VERTICAL SECTION ON LINE A-B
Horizontal Scale of Feet
0 66 132
A
CHELMSFORD ST
QUARRY
FOSSIL INSECT BED

Notwithstanding the richness in the details of the ornamentation of the fossil Coleoptera elytra, very little could be accomplished in placing the described genera and species into recognised families, so that the grouping, with two exceptions, is arbitrary. Objections to the classifying of the typed specimens into genera and species have been raised by some entomologists, while the suggestion has also been made that the specimens should be simply numbered. The rule followed, however, after due consideration of all aspects of the matter, is that which applies to fossil leaves in giving the forms both generic and specific names. No doubt a preliminary classification is best, which later investigators may modify or change entirely.

In the examination of the Denmark Hill fossils, special attention has been given to the macroscopic and microscopic descriptions of the form and ornamentation of the elytra, and as the fossils are embedded in a very fine matrix the examination resulted in some very minute structures being revealed.

In diagnosing the numerous types of elytra, the size may not be considered an important factor from a biological point of view, but experience in working out the numerous small forms of the six-inch band shows that size is unquestionably a very important aid in identification, and for this reason first consideration is given to the size of the elytra in the accompanying *Summary Table* on pages 73-75.

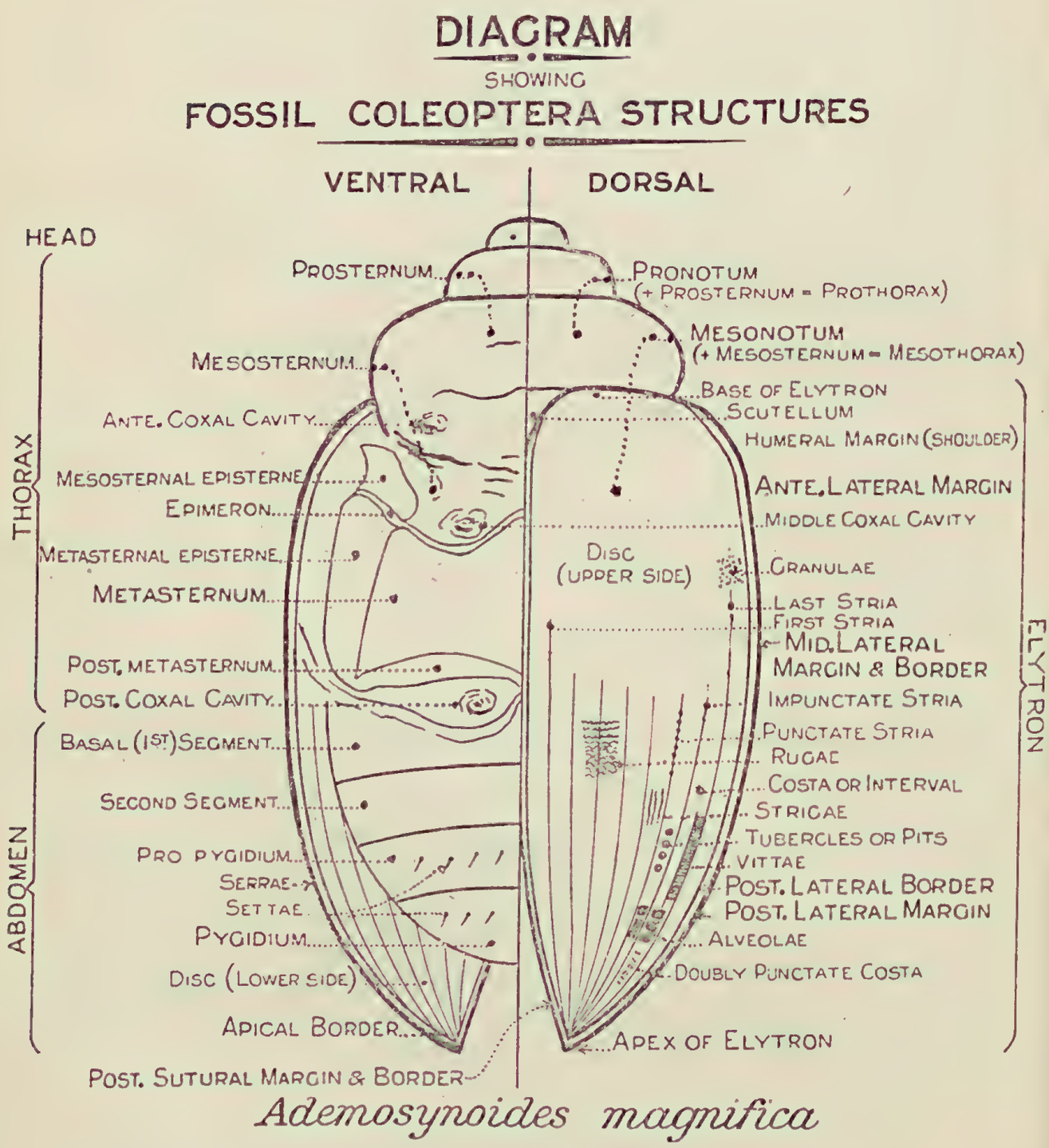
Form and Convexity can only be given approximately as both features are modified to some extent by the conditions under which the elytra have been embedded and preserved.

The diagram showing Coleoptera structures will facilitate the explanation of some of the terms used, and may be taken as a partial restoration of *Ademosynoides magnifica.*

Further searching no doubt will result in other types being revealed, and as more material will be made available sooner or later, the details of many obscure forms now in hand will be postponed for the present.

Note on the Illustrations.—The Figures illustrating the fossil insects described or referred to in the following pages are numbered from 1 to 67 respectively, and while plate numbers are also used for convenience and reference, every type or illustrated specimen has its distinctive figure number. An enlargement of one side of the specimen was usually found to be sufficient for descriptive purposes, but where the under (cast) and upper (mould) impressions vary in any way a drawing was made of

the whole of one of them and also a portion of the other, in addition to which a microscopic drawing was made of a small section of the surface of nearly all the specimens at a magnification of from 20 to 30 diameters, sometimes the centre of the disc being taken for the purpose, and occasionally a portion of the disc near one of the borders.



Ademosynoides magnifica

After due consideration was given to the best methods of illustration it was finally decided to make line drawings of all the types. Photographic methods produce some good effects where the surface convexity is low, but otherwise much detail remains obscured and would necessitate, in any case, some drawings being made to show details of structure, besides which

some specimens have to be examined at all angles and directions of lights to obtain the fine ornamental marking on them, and to illustrate this without a large number of exposures is quite beyond the power of a microscopic camera.

In making the drawings, which were executed by Mr. W. H. Reeve and myself, one operator worked on the outline and decided on the magnification, and this was checked and perhaps modified by the other operator. After agreeing to what should be produced, the rest of the structures were pencilled in with more or less detail, and after further checking and modifying, were finally inked in. There has been constant checking and altering all through the work, so that the drawings may be considered to be faithful representatives of the structures observed by two individuals working together. Even with the care exercised some of the ornamentation was found to be so delicate and shadowy that a difficulty was experienced in reproducing them, and in one or two instances the sculpture depicted in the drawings might be differently represented if examined by another observer.

Reference to the diagram showing Coleoptera Structures is made under Coleoptera Classification, and the Plan of the Quarry is referred to under Quarry Operations.

COLEOPTERA.

Fam. **HYDROPHILIDÆ.**

Genus ADEMOSYNE, Handlirsch.

Genotype *Ademosyne major*, Handlirsch.

A large number of specimens have been found in the fossil insect quarry at Denmark Hill which appear to be closely related to the original forms of *Ademosyne* described in 1908 by Handlirsch,* while many others vary from those subsequently described by Tillyard.† To retain in the one genus all the recently discovered allied forms with their many variations in structure and form would require many modifications from the original type and would certainly be very confusing, so that the necessity arose of allotting to *Ademosyne* certain groups having similar characters, and placing other groups having different characters in other new genera.

In the *Ademosyne* groups the elytra of all forms herein described are now defined to be punctate-striate and costate,

* Die Fossilen Insekten. Handlirsch. Leipzig. 1908.

† Mesozoic and Tertiary Insects of Queensland, &c. Tillyard. Queensland Geol. Survey Pub. No. 253. Brisbane, 1916.

without any abnormally wide borders, while the number of costæ or intervals on the disc, together with size, shape, and other features form specific differences. The number of costæ or intervals varies from 8 to 11, with 9 generally present, and a variation in length of elytra between 1·8 mm. and 6·2 mm.

Included now in *Ademosyne* are *A. Olliffi* and *major* of Handlirsch, and *A. australiensis, congener, punctata* and *Cameroni* of Tillyard, together with nine new species. The species removed from *Ademosyne* and placed in the new genus *Ademosynoides* are *A. minor* of Handlirsch, and *A. obtusa* and *angusta* of Tillyard, in addition to five new species, while in a third genus, *Platycrossos* is placed *A. tumida,* Tillyard, and two other new species.

Thoracic characters are well-illustrated in *Ademosynoides magnifica* and indicate the Hydrophilidæ affinities of the genus. This species, however, is the only one found which shows at all clearly the body structures, so that no generalizations can be made. With more material available, and this will be forthcoming sooner or later, *Ademosynoides magnifica* (as a generic form) might be further separated from *Ademosyne major,* on account of the preserved, although obscure, thoracic impressions of the latter showing metasternal differences from the former.

ADEMOSYNE OLLIFFI, *Handlirsch.*

Fig. 9, plate 1.

Ademosyne Olliffi, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

Pseudorrhynchophora Olliffi, Handlirsch. Die Fossilen Insekten, Leipzig, 1908.

Rhynchophorous beetle, Etheridge and Olliff. Mem. Geol. Surv. N.S.W., Palæontology, No. 7. Sydney, 1890.

ELYTRON.—

Size.—*Length,* 1·8 mm.; *width,* 0·7 mm. (the smallest species of *Ademosyne*).

Outline.—*Apex,* obtusely rounded; *base,* long, curvate; *sutural margin,* arcuate; *lateral margin,* slightly curvate from humerus to three-quarters of the length of disc, then arcuate to apex; *scutellary margin,* short; *humeral margin,* sub-angulate; *general outline,* elongate-ovate.

Ornamentation.—*All borders* very narrow; *striæ,* not pronounced, faintly punctate, all irregularly converging to apex; *costæ,* 9, round, faintly crenulate laterally.

Convexity.—Disc, rather low, slightly declivous along lateral margin.

Illustrations.—Fig. 9, plate 1 (Spec. 35 × 30) fairly represents the general outline of the elytron and the arrangement of the striæ. Fig. 9*a* (part of Spec. 35 × 50) shows the punctæ and the faintly crenulate striæ.

Observations.—This minute species is comparable with *Ademosynoides minor,* from which it differs in its striæ being punctate and in the disc being shorter and narrower. It also resembles *A. parva,* but the shape is not the same, the punctures are not so conspicuous, and the scutellary margin is much shorter.

Type.—Spec. S1 (Simmond's Coll.) Paratypes.—Spec. 35. (Fig. 9, plate 1) cast (G.S.Q. Coll.); Spec. 115, B. D. Coll.

ADEMOSYNE PARVA, *sp. nov.*

Fig. 8, plate 1.

ELYTRON.—

Size.—*Length,* 2 mm.; *width,* 0·8 mm.

Outline.—*Apex,* acute; *base,* nearly straight, somewhat short; *sutural margin,* arcuate from scutellary margin to apex; *lateral margin,* arcuate from humerus to apex; *scutellary margin,* long; *humeral margin,* obtusely sub-angulate; *general outline,* naviculate-ovate.

Ornamentation.—*All borders,* narrow, the lateral one well-defined, all much narrower than costæ; *costæ,* 8 or 9, round, finely granulate, distinct and wide near sutural side; *striæ,* deep near sutural border, punctate, strongly so towards scutellary margin, some of the striæ converging to apex, others coalescing with lateral border.

Convexity.—Somewhat high, very high near scutellary margin.

Illustrations.—Fig. 8, plate 1 (Spec. 312*a* × 30) shows the pronounced scutellary margin and the deeply punctate striæ near the sutural side. Fig. 8*a* (part of Spec. 312*a* × 50) is a section across the costæ and the more pronounced punctate-striæ.

Observations.—This *little* species has much in common with *A. intermedia*, from which it is distinguished in being smaller, narrower, and more finely tapered. It has also a decided scutellary margin, near which the striæ are deeply punctate. It differs from *A. Olliffi* in shape, size, costal arrangement and punctæ, and from *A. major* in coarseness of punctæ and size.

Type.—Spec. 312*a* (cast); Fig. 8, plate 1 (G.S.Q. Coll.); Type-counterpart.—312*b* (mould). B. D. Coll.

ADEMOSYNE INTERMEDIA, *sp. nov.*

Fig. 2, plate 1.

ELYTRON.—

Size.—*Length*, 2·2 mm.; *width*, 1·1 mm.

Outline.—*Apex*, obtuse; *base*, irregularly curvate, somewhat long; *sutural margin*, arcuate from apex to scutellary margin; *scutellary margin*, long, confluent with sutural margin; *lateral margin*, strongly arcuate from apex to humerus; *humeral margin*, round; *general outline*, wide-ovate, narrowing gently from middle to apex.

Ornamentation.—*All borders* narrower than costæ and about equal to one another in width; *costæ*, 8, granulate, slightly carinate in places on apical half, otherwise round, nearly all equal in width, all uniformly converging to apex; *striæ*, deep, strongly punctate.

Convexity.—*Disc*, uniformly high.

Illustrations.—Fig. 2. (Spec. 233*b* × 30) shows the round costæ on the middle portion merging into sub-carinate costæ towards the apex. Fig. 2*a* (part of Spec. 233*b* × 40) shows a section of some of the carinate costæ with deeply punctate striæ.

Observations.—*A. intermedia*, which is between *A. parva* and *major* in size, has nearly the shape and size of *A. lata*, but has different borders and costæ, and the striæ is punctate. With *Ademosynoides minor* and *A. brevis* it may also be compared, but differs from the former in being larger, proportionately wider, and in the striæ being punctate, while from *A. brevis* it differs in size, in the costæ being carinate, and in the striæ being deeply punctate. A comparison might also be made with *A. major*, from which it varies in size, shape, borders, and character of punctæ and costæ.

Type.—Spec. 233*b* (cast); Fig. 2, plate 1. (G.S.Q. Coll); Type-counterpart.—Spec. 233*a* (mould). B. D. Coll.

ADEMOSYNE LATA, *sp. nov.*

Fig. 5, plate 1.

ELYTRON.—

Size.—*Length,* 2·2 mm.; *width,* 1.1 mm.

Outline.—*Apex,* unknown; *base,* long, straight; *sutural margin,* strongly arcuate, *scutellary margin,* short (?), confluent with sutural margin; *humeral margin,* angulate, porrect, confluent with base and *lateral margin,* the latter gently arcuate; *general outline,* ovate.

Ornamentation.—*Sutural border,* explanate, about half as wide as costæ; *lateral border,* as wide as sutural border near the middle of elytron, widening to a very pronounced humeral border; *costæ,* 9, somewhat explanate, smooth, equally wide about the middle, regularly converging to both apex and base; *striæ,* deep, narrow, generally impunctate, but finely punctate in places.

Convexity.—*Disc,* moderately high, wide humeral border explanate.

Illustrations.—Fig. 5 (Spec. 132*a* × 30) shows the pronounced humeral area, the regular costæ and striæ, and the oval shape, while Fig. 5*a* (part of Spec. 132*a* × 50) is an enlargement showing the smooth costæ and the fine striæ.

Observations.—The development of the humerus in this small but *wide* species is only comparable with *Platycrossos tumidus* and *P. sub-tumidus,* from which it is distinguished by size, and by differences in the character of the costæ and borders.

Type.—Spec. 132*a* (mould); Fig. 5, plate 1. (G.S.Q. Coll); Type-counterpart.—Spec. 132*b* (cast). B. D. Coll.

ADEMOSYNE MAJOR, *Handlirsch.*

Fig. 1, plate 1, and Fig. 12, plate 2.

Ademosyne major, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

Ademosyne major, Handlirsch. Die Fossilen Insekten. Leipzig, 1908.

Hydrophilidæ (?), Etheridge and Olliff. Mem. Geol. Surv. N.S.W.; Palæontology, No. 7. Sydney, 1890.

THORAX.—

Metasternum.—Depth about half the mean width; anterior margin slightly narrower than posterior, strongly sinuate

posterior to intermediate coxal cavities; posterior margin almost straight from side to side. METASTERNAL EPISTERNUM.—Extends the full length of metasternum; the sides converging almost to a point, posteriorly. EPIMERON.—Not observed. MESOSTERNAL EPISTERNUM.—Strongly arched anteriorly, apparently anastamosing with metasternal episternum. COXÆ.—Intermediate coxal cavities, apparently as far apart as half the width of metasternum at the posterior end. Posterior coxal cavities, apparently closer together than intermediate cavities. ORNAMENTATION.—Obscure.

ABDOMEN.—

SEGMENTS.—Basal segment longer on sides than at centre; 2nd, 3rd, and 4th nearly equal in length; pygidium longer; altogether forming a dome of which the height is equal to the diameter.

ELYTRON.—

SIZE.—*Length,* 2·6 mm.; *width,* 1 mm.

OUTLINE.—*Apex,* acutely rounded; *base,* short, slightly curvate, confluent with round *humeral margin,* the later merging into a moderately arcuate *lateral margin; scutellary margin,* long, forming an obtuse angle with base; merging into an arcuate *sutural margin; general outline,* uniform taper to apex from one-third the length from base.

ORNAMENTATION.—*Sutural border,* narrower than costæ; *scutellary border,* narrow; *lateral border,* very slightly narrower than sutural border; *costæ,* 8 or 9, round, granulate, wider on lateral than on sutural side; several converging to apex, a few joining lateral border, in some specimens one bifurcating near the humerus; *striæ,* deep, finely punctate at regular intervals.

CONVEXITY.—*Disc,* moderately high in type specimen, but varies.

ILLUSTRATIONS.—Fig. 1 (Spec. 36*a* × 30) shows the sutural margin too pronounced, and the number of costæ is incorrectly shown to be 10. Fig. 1*a* (part of Spec. 36*a* × 50) illustrates the distinct costæ and the deep but finely punctate striæ. Fig. 12 (Spec. S2) shows a trace of the base of one of the elytra, the impressions of the thorax and abdomen, and the extension of the elytra beyond the pygidium.

OBSERVATIONS.—The bifurcation of one of the costæ near the base is observed in a number of specimens, but the character is hardly sufficient for varietal distinction. Comparisons may be

made with *A. intermedia, A. brevis,* and *Ademosynoides obtusa,* from the first differing in the character of its borders, costæ and striæ, from the second in being much narrower and in the appearance of its costæ, while from the third, to which perhaps it comes nearest, it varies in having punctate striæ and a more decided scutellary margin. It is much smaller than *A. australiensis* and has not the apical arrangement of the costæ of that species, while from *Ademosynoides alternata* it is separated by differences in size, costal sculpture and striæ.

Type.—Spec. S2 (cast); Fig. 12, plate 2. (Simmond's Coll.) Paratype.—Spec. 36*a* (mould); Fig. 1, plate 1. (G.S.Q. Coll.) Paratype-counterpart.—Spec. 36*b* (cast), paratype, Spec. 10 (B. D. Coll).

Ex-paratype.—Spec. 44, previously referred to this species, has now been assigned to *A. australiensis.*

ADEMOSYNE BREVIS, *sp. nov.*

Fig. 6, plate 1.

ELYTRON.—

Size.—*Length,* 2·6 mm.; *width,* 1·4 mm.

Outline.—*Apex,* very obtusely rounded and incurved; *base,* long, irregular; *sutural* and *scutellary margins,* both nearly arcuate; *lateral margin,* arcuate from apex to humerus, but not so pronounced as sutural margin; *humeral margin,* round; *general outline,* piriform-ovate.

Ornamentation.—*Sutural* and *scutellary borders,* narrow; *lateral border,* wider than sutural border on apical half, slightly wider towards *humeral border,* the latter still wider but rapidly disappearing where it joins the base; *costæ,* 9, round, granocrenulate, variable in width from one another, those near sutural side narrowest, those about the centre widest, each tapering both apically and basally; *striæ,* distinct, clearly punctate.

Convexity.—Moderately and uniformly low, except at apex.

Illustrations.—Fig. 6 (Spec. 339*a* × 30) shows correctly the general arrangement of the borders, costæ and striæ, but does not well illustrate the apical declivity. Fig. 6*a* (part of Spec. 339*a* × 40) is a section showing the crenulations on the costæ crossing from one stria to another.

Observations.—The *short* piriform outline and the reflexed apex separate this species from all others. The size, striæ and sutural characters separate it from *A. lata,* and its shorter

outline, size, costæ and striæ from *A. intermedia.* Its differences from *A. major* have already been given in describing that species.

TYPES.—Spec. 339*a* (cast); Fig. 6, plate 1. (G.S.Q. Coll.)
TYPE-COUNTERPART.—Spec. 339*b* (mould). B. D. Coll.

ADEMOSYNE CURVATA, *sp. nov.*

Fig. 7, plate 1.

ELYTRON.—

SIZE.—*Length,* 2·8 mm.; *width,* 1 mm.

OUTLINE.—*Apex,* obtusely pointed; *base,* long, curvate; *sutural* and *lateral margins,* both nearly arcuate, the former gently, the latter more pronounced; *scutellary margin* confluent with sutural margin, forms obtuse angle with base; *humeral margin,* round, confluent with the lateral margin and base; *general outline,* oblong-ovate, the sutural and lateral sides gently tapering from the middle of the disc to both apex and base.

ORNAMENTATION.—*All borders,* equally narrow, less in width than costæ and sharply defined; *costæ,* 8 (?), smooth, all nearly equal in width, all concentric with lateral border. At the apical end all curve around to join the sutural border at angles varying with their positions, some join at nearly right angles, others acuminately, while at the basal end six join the margin at about a right angle; two others nearer the sutural border join the scutellary border at an acute angle, and a short, doubtful, narrow one, tapering both ends (making the 9th), joins the sutural border very acutely; *striæ,* defined, with round, deep punctæ.

CONVEXITY.—Moderately low all over the disc.

ILLUSTRATIONS.—Fig. 7 (Spec. 274*a* × 30) shows the general curvature of the costæ and striæ, and Fig. 7*a* (part of Spec. 274*a* × 50) indicates the narrow border to be sharply defined and the punctures to be large and clearly separated from one another.

OBSERVATIONS.—This species resembles *Ademosynoides obtusa* in size, shape, and in having uniformly narrow borders, and has also a resemblance to *A. rugulosa* in the wrinkled appearance observed in some specimens. No other species has the concentrically *curvate* costæ, and no approach to this character of sculpture has been observed in other forms.

TYPE.—Spec. 274*a* (cast); Fig. 7, plate 1. (G.S.Q. Coll.)
TYPE-COUNTERPART.—Spec. 274*b* (mould). B. D. Coll.

ADEMOSYNE AUSTRALIENSIS, *Tillyard.*

Fig. 3, plate 1.

Ademosyne australiensis, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length,* 3·4 mm.; *width,* 1·2 mm.

Outline.—*Apex,* very bluntly rounded; *base,* straight, somewhat short; *sutural margin,* arcuate; *scutellary margin,* short, inconspicuous, forming obtuse angle with base; *humeral margin,* round, confluent with base and lateral margin; *lateral margin,* straight from humerus for two-thirds the length of disc, then arcuate to the round apex; *general outline,* elongate-ovate.

Ornamentation.—*All borders,* somewhat narrow but variable, scutellary border in some specimens very narrow; *costæ,* 10, smooth, somewhat depressed, usually delicate, variable in width on all parts of the disc, all taper to the blunt apex but do not anastomose, and near the extremity all slightly bend towards the posterior sutural margin; *striæ,* defined, punctate.

Convexity.—Generally high.

Illustrations.—Fig. 3 (Spec. 12*b* × 25) shows the irregularities of the costæ, their difference in width, individual variations, and apical curvature. Fig. 3*a* (part of Spec. 12*b* × 50) illustrates the rather flat, smooth costæ, and the closely set punctæ on the striæ.

Observations.—Differences in size and shape separate this form from *A. major,* and variations in costal sculpture separate it from *A. rugulosa* and *A. curvata.* It has some resemblance to *Ademosynoides alternata,* but that species has alternating costæ and impunctate striæ.

Type.—Spec. 12*b* (cast); Fig. 3, plate 1. Paratype.—Spec. 44. (G.S.Q. Coll.) Type-counterpart.—Spec. 12*a* (mould). B. D. Coll.

ADEMOSYNE RAMO-COSTATA, *sp. nov.*

Fig. 4, plate 1.

ELYTRON.—

Size.—*Length,* 3·5 mm.; *width,* 1·4 mm.

Outline.—*Apex,* obtusely pointed; *base,* very short, nearly straight; *sutural margin,* very gently arcuate from scutellary margin to apex; *scutellary margin,* very short; *lateral margin,*

strongly arcuate from apex to humeral margin, with which it is confluent; *humeral margin,* very long, nearly straight, forms obtuse angle with the short basal margin; *general outline,* widely tapered to apex from one-third the length from base.

Ornamentation.—*Sutural border,* much narrower than adjacent costa; *lateral border,* somewhat wider than opposite sutural border, about equal in width to adjacent costa, confluent with pronounced humeral border; *costæ,* 10, round, smooth, six of equal width occupying two-thirds the distance across middle of disc from sutural margin, four others narrowing in width towards lateral margin. The six wide costæ slightly converge to the base, the four narrow ones joining with the long humeral border. Towards the base the fifth large central costa tapers off between the two adjacent costæ, the latter coalescing posteriorly to form a ramose structure. Other costæ meet posteriorly in the same manner but become somewhat evanescent near the apex; *striæ,* distinct, finely punctate.

Convexity.—Generally high, in humeral area very high.

Illustrations.—Fig. 4 (Spec. 225 × 25) shows the symmetrically arranged costæ and the pronounced humeral margin. Fig. 4*a* (part of Spec. 225 × 40) represents a section where the costæ meets to form the ramose or "Y" branches, which, however, are nearer the sutural (right) margin than shown in the drawing.

Observations.—The *branching* costæ is a feature which separates the species from all other forms of *Ademosyne,* while from *Platycrossos tumidus* it is distinguished in size, shape, and convexity, and by the different shape of its borders.

Type.—Spec. 225 (cast); Fig. 4, plate 1. (G.S.Q. Coll.)

ADEMOSYNE RUGULOSA, *sp. nov.*

Fig. 10, plate 1.

ELYTRON.—

Size.—*Length,* 3·6–4·2 mm.; *width,* 1·3–1·4 mm.

Outline.—*Apex,* obtusely pointed; *base,* short, irregularly curvate; *sutural margin,* gently arcuate; *lateral margin,* strongly arcuate; *humeral margin,* round; *scutellary margin,* short; *general outline,* oblong-ovate.

Ornamentation.—*Sutural* and *lateral borders,* somewhat variable in width, but generally less than width of costæ;

scutellary and *humeral borders*, indistinct, but evidently narrow; *costæ*, 9 to 11, somewhat explanate, minutely granulate, finely rugose cross-wise, regularly disposed, mostly converging to apex, a few joining and converging to the posterior lateral border; *striæ*, well-defined, distinctly and finely punctate.

Convexity.—Moderately high, rather pronounced apical declivity.

Illustrations.—Fig. 10 (Spec. 260*a* × 20) shows the general character of the disc sculpture and the bifurcation of the stria nearest to the lateral border. The borders in the figure are drawn slightly too narrow. Fig. 10*a* (part of Spec. 260*a* × 35) shows the grano-rugose, flattish costæ, and the defined punctures.

Observations.—This *wrinkled* species somewhat resembles *A. australiensis*, from which it differs in sculptural details, particularly in the costal convergence at the apex. The bifurcation of the stria near the humerus is a similar feature to that observed in some specimens of *A. major*.

Type.—Spec. 260*a* (cast); Fig. 10, plate 1. (G.S.Q. Coll.)
Type-counterpart.—Spec. 260*b* (mould). B. D. Coll.

ADEMOSYNE VITTAMARGINA, *sp. nov.*

Fig. 13, plate 2.

ELYTRON.—

Size.—*Length*, 4 mm.; *width*, 1·4 mm.

Outline.—*Apex*, obtusely pointed; *base*, round; *sutural* margin, gently curvate; *lateral margin*, strongly arcuate; *humeral* and *scutellary margins* confluent with base, the former also confluent with lateral margin and the latter with sutural margin; *general outline*, elongate-ovate.

Ornamentation.—*All borders*, uniformly narrow, forming one unbroken vitta around the disc; *costæ*, 10, faintly perceptible (in type specimen), explanate, finely pustulate; *striæ*, faintly punctate. Spec. 293*a* (paratype) shows more pronounced costæ and striæ.

Convexity.—Very low and somewhat irregular.

Illustrations.—Fig. 13 (Spec. 341*a* × 20) shows the faint ornamentation and the narrow straped border. Fig. 13*a* (part of Spec. 341*a* × 40) shows rather incorrectly the character of the minute pimples on the costæ. They are much more uniform than indicated, and also more delicate.

Observations.—The *band-like* uniformity and the narrowness of the borders are a feature of the species, which, with its faint sculpture and low convexity, separates it from all other forms of *Ademosyne*. Indeed, further research might reveal specimens showing that it should not be included in this genus at all.

Type.—Spec. 341*a* (cast); Fig. 13, plate 2. (G.S.Q. Coll.)
Type-counterpart.—Spec. 341*b* (mould). B. D. Coll.
Paratype.—Spec. 293*a* and 293*b*.

ADEMOSYNE CONGENER, *Tillyard.*

Fig. 16, plate 2.

Ademosyne congener, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length*, 4·5 mm.; *width*, 2·1 mm.

Outline.—*Apex*, obtusely rounded; *base*, long, nearly straight; *sutural* and *lateral margins*, almost equally and strongly arcuate; *scutellary margin*, very short; *humeral margin*, sub-angulate; *general outline*, ovate, tapering from middle to both apex and base.

Ornamentation.—*All borders*, somewhat narrow, regular; *costæ*, 9 or 10, round, nearly smooth, unequal in width, lateral costæ much wider than sutural, the latter slightly less than adjacent costæ, all evanescent towards the base, all converging and becoming more pronounced towards apex; *striæ*, finely punctate, deep near apex, almost imperceptible near base.

Convexity.—Moderately high, apical declivity pronounced.

Illustrations.—Fig. 16 (Spec. 40 × 18) shows the general irregularity in the width of the costæ, and one irregular stria near humerus. It also shows an impression of what might be a wide basal border. Fig. 16*a* (part of Spec. 40 × 40) illustrates the rather flat costæ and the deep punctate striæ at the middle of the disc.

Observations.—This is a *kindred* species to *A. Cameroni*, which it resembles in costal arrangement, but differs in being much smaller. It also resembles *Ademosynoides abnormis* which, however, is impunctate. In size it is comparable with *A. punctata*, from which it differs in sculpture and in shape. Somewhat resembles *A. australiensis*, but is more tapering, wider in proportion, and the sculpture less pronounced.

TYPE.—Spec. 40 (cast); Fig. 16, plate 2. PARATYPES.—Specs. 41*b* (cast) and 42 (cast). (G.S.Q. Coll.) PARATYPE.—Spec. 41*a* (mould). B. D. Coll.

ADEMOSYNE PUNCTATA, *Tillyard.*

Fig. 15, plate 2.

Ademosyne punctata, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

SIZE.—*Length,* 4–4·2 mm.; *width,* 1–1·3 mm.

OUTLINE.—*Apex,* acutely rounded; *base,* long, irregularly curvate; *sutural* and *lateral margins,* both gently arcuate; *general outline,* subulate-ovate.

ORNAMENTATION.—*Sutural* (*?*) *border* narrow at apex, becoming wider towards humeral border, with which it is confluent; *scutellary border* short, gradually widening and becoming confluent with a very wide and pronounced *basal border; humeral border,* small, confluent with basal border and with *lateral border,* the latter disappearing close to humerus, appearing again about the middle of the margin, and extending narrowly to apex; *striæ,* 8, shallow, distinctly punctate, all nearly equally spaced, converging to apex; *intervals,* flat, smooth (*?*), faintly punctate generally, more pronounced towards the base.

CONVEXITY.—Moderately high.

ILLUSTRATIONS.—Fig. 15 (Spec. 47*b* × 25) shows the pronounced punctate striæ alternating with the faintly punctate striæ. Fig. 15*a* (part of Spec. 47*b* × 50) gives further details of the arrangement of the punctæ.

OBSERVATIONS.—No other species of *Ademosyne* possess the doubly *punctate* structure. In its slender tapering form it has in this genus no parallel, but might be compared with *Ademosynoides attenuata* and the two species of *Tryoniopsis.*

TYPE.—Spec. 47*b* (cast); Fig. 15, plate 2. (G.S.Q. Coll.) TYPE-COUNTERPART.—Spec. 47*a* (mould). B. D. Coll.

ADEMOSYNE ADUNCA, *sp. nov.*

Fig. 14, plate 2.

ELYTRON.—

SIZE.—*Length,* 6 mm.; *width,* 2·2 mm.

OUTLINE.—*Apex,* obtusely pointed; *base,* long, irregularly

sinuate; *sutural* and *lateral margins,* both arcuate, the former more gently than the latter; *scutellary (?)* and *humeral (?) margins* each round, confluent with the base and adjacent margin; *general outline,* narrow-ovate.

Ornamentation.—*Sutural* and *lateral borders,* each narrower than adjacent costa, the former merging into a wide scutellary border, the latter into a moderately wide humeral border, both *humeral* and *scutellary borders* merging into a wide irregular basal border; *costæ,* 10, very finely granulate, generally low, explanate towards base, both uniform in width and slightly converging towards the apex, which is reflexed; *striæ,* faint near base where one diverges at an acute angle towards humeral border, finely but distinctly punctate; *strigæ,* crosses reflexed apex at end of costæ rectangularly, and covers this part of the elytron.

Convexity.—Moderately and uniformly low.

Illustrations.—Fig. 14 (Spec. 194*b* × 12) shows the arrangement of the striæ near the base and the strigose feature at the incurved apex. Fig. 14*a* (part of Spec. 194*b* × 25) illustrates the narrow flattish costæ and the finely punctate striæ.

Observations.—This species in having a *reflexed* apex is quite distinct from any of the other *Ademosyne* forms, but otherwise has many of the characters of this genus. It is comparable in length and in its punctæ with *A. Cameroni,* but is much more slender. *Ademosynoides abnormis* resembles it in size, shape, and border characters, the *striæ* of which, however, is impunctate.

Type.—Spec. 194*b* (cast); Fig. 14, plate 2. (G.S.Q. Coll.)
Type-counterpart.—Spec. 194*a* (mould). B. D. Coll.

ADEMOSYNE CAMERONI, *Tillyard.*

Fig. 11, plate 2.

Ademosyne Cameroni, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length,* 6·2 mm.; *width,* 3 mm.

Outline.—*Apex,* obtusely pointed; *base,* very long, slightly curvate; *sutural* and *lateral margin,* equally and moderately arcuate from base to apex; *scutellary (?) margin,* confluent with

sutural margin, joins base at an acute angle; *humeral (?) margin,* round, confluent with lateral margin and base; *general outline,* triangulate-ovate.

Ornamentation.—*Sutural* and *lateral borders,* equally narrow, the latter centrally striolate; *basal border,* very wide near scutellum, where it becomes suddenly narrow, not so wide near humerus, where it also becomes narrow and confluent with lateral border; *costæ,* 9, equal, round, converging towards the apex, explanate towards the base, smooth near base, rough near apex; *striæ,* finely and distinctly punctate, deep near apex, shallow towards base, one stria near the latter considerably bent.

Convexity.—Low near base, becoming moderately high towards apex.

Illustrations.—Fig. 11 (Spec. 46*b* × 15) shows the uniform triangulate-ovate shape of the elytron, the distinct punctæ near the base, and the irregularity in the 5th stria. Fig. 11*a* (part of Spec. 46*b* × 25) illustrates the rotundity and roughness of the costæ, and the distinctly punctate striæ near the apex.

Observations.—This species closely resembles *Ademosynoides abnormis* in many characters, the difference being in size, shape and punctæ. Some parts of the sculpture in the two species are so much alike that some probability exists of the two forms being male and female of the one species, but more evidence is required. Although *A. congener* has some features common to the species, it is much smaller and the shape and parts of the sculpture are different.

Type.—Spec. 46*b* (cast); Fig. 11, plate 2. (G.S.Q. Coll.)
Type-counterpart.—Spec. 46*a* (mould). B. D. Coll.

Genus ADEMOSYNOIDES, gen. nov.

Genotype *Ademosynoides minor* (Handlirsch).

This new genus comprises eight species, in all of which the elytra are impunctate-striate, all except one have 9 or 10 costæ or intervals, and all have narrow or only moderately wide borders. Sizes of elytra vary from 2 mm. (*A. minor*) to 8·5 mm. (*A. magnifica*), while the shapes, as with *Ademosyne,* have considerable variation.

ADEMOSYNOIDES MINOR (Handlirsch).

Fig. 18, plate 2.

Ademosyne minor, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

Ademosyne minor, Handlirsch. Die Fossilen Insekten. Leipzig, 1908.

Hydrophilidæ (?), Etheridge and Olliff. Memoirs, Geol. Surv. N.S.W. Palæontology, No. 7. Sydney, 1890.

ELYTRON.—

Size.—*Length*, 2 mm.; *width*, 0·8 mm.

Outline.—*Apex*, obtusely pointed; *base*, round; *sutural* and *lateral margins*, almost equally sinuate and confluent with base; *general outline*, oblong-ovate.

Ornamentation.—*All borders*, equally narrow, less than width of costæ; *costæ*, 9, round, smooth, parallel and equal in width across the middle of disc, rapidly and uniformly tapers to apex from midway between middle and apex; *striæ*, impunctate, pronounced, except on basal quarter.

Convexity.—High.

Illustrations.—Fig. 18 (Spec. 38*b* × 30) shows the evenness of the costæ, and the apical declivity, while Fig. 18*a* (part of Spec. 38*b* × 50) illustrates the distinct but impunctate striæ.

Observations.—This not uncommon species resembles *A. obtusa* in costal and marginal ornamentation and in the striæ being impunctate, but it is smaller, the shape is not the same, and the basal portion is quite different. Compared to *A. angusta* it is small and wide, and compared to *Ademosyne Olliffi* it is large and wide, the latter also having ill-defined punctate striæ.

Type.—Spec. S3 (cast), Simmond's Coll. Paratype.—Spec. 38*b* (cast); Fig. 18, plate 2. (G.S.Q. Coll.) Paratype-counterpart.—Spec. 38*a* (mould). B. D. Coll.

ADEMOSYNOIDES OBTUSA (*Tillyard*).

Fig. 17, plate 2.

Ademosyne obtusa, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length*, 2·4 mm.; *width*, 1 mm.

Outline.—*Apex*, obtusely pointed; *base*, long, nearly straight, confluent with a pronounced and round *humeral*

margin; lateral margin, moderately arcuate from humeral margin, with which it is confluent, to apex; *sutural margin,* as arcuate as lateral margin, confluent with *scutellary margin,* the latter forming an obtuse angle with the base; *general outline,* elongate-ovate.

Ornamentation.—*All borders,* narrow, sutural more so than lateral, scutellary narrower than sutural, basal border as narrow as sutural and well-defined; *costæ,* 9, round, finely granulate, all of uniform width across the middle of disc, slightly tapering towards base, sharply tapering to apex; *striæ,* uniform, distinct, impunctate, one joining scutellary border and at the other end joining the posterior sutural border, all others reaching both apex and base.

Convexity.—High (in type specimen), but varies.

Illustrations.—Fig. 17 (Spec. 9*b* × 30) shows the uniformity in shape and ornamentation. Fig. 17*a* (part of Spec. 9*b* × 50) illustrates the round, finely granulate costæ and the impunctate striæ, while irregularities are also shown to be present on the costæ close to the striæ.

Observations.—This species with the *obtuse* apical angle has some resemblance to *A. angusta,* but it has a much wider disc and the borders are different. It also may be compared to *A. alternata* and *Ademosyne australiensis,* but the outline and sculpture of both these forms are not the same.

Type.—Spec. 9*b* (cast); Fig. 17, plate 2. (G.S.Q. Coll.)
Type-counterpart.—Spec. 9*a* (mould). B. D. Coll.

ADEMOSYNOIDES ALTERNATA, *sp. nov.*

Fig. 19, plate 2.

ELYTRON.—

Size.—*Length,* 2·5 mm.; *width,* 1 mm.

Outline.—*Apex,* somewhat obtusely rounded; *base,* round; *sutural margin,* moderately arcuate, confluent with long *scutellary margin* and base; *lateral margin,* confluent with basal margin, gently arcuate for three-quarters the length of disc from base, then slightly curved to apex; *general outline,* elongate-ovate.

Ornamentation.—*Sutural border,* somewhat narrower than adjacent costæ and opposite lateral border, confluent with *apical border,* which has the same width; *scutellary border,* confluent

with sutural border, evanescent towards base; *lateral border,* as wide as adjacent costæ near middle of disc, gradually narrowing to join apical border, evanescent on humeral margin near base; *costæ,* 8, round, finely punctate, alternately high and low, nearly equal in width across the middle of disc, converging gently both to base and apex; *striæ,* distinct, impunctate.

Convexity.—High, except on the basal quarter, where the disc is explanate.

Illustrations.—Fig. 19 (Spec. 149*a* × 30) shows the alternating and more or less arcuate costæ, the difference between the high and low costæ, however, being shown too conspicuously on the lateral portion. The figure also shows the flattened apex. Fig. 19*a* (part of Spec. 149*a* × 40) is a section taken from near the centre.

Observations.—In size the species is comparable with *A. obtusa,* and *Ademosyne curvata,* and in shape with *Ademosyne australiensis,* but its *alternating* costæ and depressed apical quarter are distinguishing characters.

Type.—Spec. 149*a* (cast); Fig. 19, plate 2. (G.S.Q. Coll.)
Type-counterpart.—Spec. 149*b* (mould). B. D. Coll.

ADEMOSYNOIDES STRIATELLA, *sp. nov.*

Fig. 26, plate 3.

ELYTRON.—

Size.—*Length,* 2·8 mm.; *width,* 1·1 mm.

Outline.—*Apex,* very obtusely rounded; *base,* long, curvate; *sutural margin,* gently curvate, confluent with base and apex; *lateral margin,* moderately arcuate, confluent with base and apex; *scutellary* and *humeral margins,* confluent with other adjoining margins; *general outline,* elongate-ovate.

Ornamentation.—*All borders,* very narrow, lateral one specially so; *costæ,* 9 or 10, somewhat explanate, finely granulate across middle of disc, all nearly equal in width, converging uniformly to base and towards apex. Close to the latter the costæ all anastamose abruptly, forming one very narrow, well-defined central costa, which extends to the apical margin; *striæ,* deep, impunctate, uniform with costæ towards base, the central stria and the second one on either side being short and in conformity with the costal complication near apex.

Convexity.—Moderately low.

Illustrations.—Fig. 26 (Spec. 16*a* × 20) shows the general arrangement of the costæ. Fig. 26*a* (part of Spec. 16*a* × 35) represents a section taken across the centre of the disc near the apex, and illustrates the costal sculpture.

Observations.—The species somewhat resembles *A. obtusa* and *A. angusta* in shape and size, and the latter also in being impunctate, but the coalescing of the costæ and the *short striæ* thus produced is a very conspicuous feature. There is just the possibility that *A. striatella* and *A. angusta*, in being so much alike, are the male and female of the one species. The type specimen of the former was included with the latter originally, as a co-type, but later discoveries show that what was thought to be a sport was a persistent feature in a number of specimens.

Type.—Spec. 16*a* (cast); Fig. 26, plate 3. (G.S.Q. Coll.)
Type-counterpart.—Spec. 16*b* (mould). B. D. Coll.

ADEMOSYNOIDES ANGUSTA, *Tillyard.*

Fig. 20, plate 3.

Ademosyne angusta, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length*, 3 mm.; *width*, 1 mm.

Outline.—*Apex*, obtusely pointed; *base*, irregular in type specimen, but round in others; *sutural* and *scutellary margins*, confluent, together curvate from base to apex; *lateral* and *humeral margins*, together moderately arcuate from base to apex; *general outline*, narrow-ovate.

Ornamentation.—*Sutural* and *scutellary borders*, narrow; *lateral* and *humeral borders*, ill-defined, probably very narrow; *costæ*, 9 or 10, somewhat explanate, finely granulate, about the middle of disc nearly equal in width and parallel towards base, those on sutural half being parallel to one another, on lateral half convergent. Towards the base, where they are faint, those on lateral half slightly converge to apical extremity, others are nearly parallel with one another and coalesce with posterior sutural margin; *striæ*, deep, impunctate, evanescent towards apex.

Convexity.—Low.

Illustrations.—Fig. 20 (Spec. 15*b* × 25) does not show a complete lateral margin, but in other specimens this is shown to be narrow. Fig. 20*a* (part of Spec. 15*b* × 50) illustrates the flattish costæ and the impunctate but distinct striæ.

Observations.—Comparisons may be made with *A. striatella* and *A. obtusa*, but this species is *narrower* and flatter, and the apical characters of the costæ are different from either. It has also resemblances to *Ademosyne major*, *Ademosyne curvata*, *A. minor*, and *A. alternata*, which see under their respective headings.

Type.—Spec. 15*b* (cast); Fig. 20, plate 3. (G.S.Q. Coll.)
Type-counterpart.—Spec. 15*a* (mould). B. D. Coll.
Ex Co-Type.—Spec. 16*a*, 16*b*, is now the Type and Type-counterpart of *A. striatella*.

ADEMOSYNOIDES ABNORMIS, *sp. nov.*

Fig. 23, plate 3.

ELYTRON.—

Size.—*Length*, 6·2 mm.; *width*, 2·5 mm.

Outline.—*Apex*, obtusely pointed; *base*, curvate; *sutural* and *lateral margins*, moderately curvate to apex from one-third the length of elytron from base; *humeral margin*, sub-angulated with lateral margin, confluent with base; *scutellary margin*, short, round, confluent with base and sutural margin; *general outline*, elongate-ovate.

Ornamentation.—*Sutural* and *lateral borders*, narrow, singly striolate; *humeral border*, moderately narrow, confluent with lateral border and *basal border*, the latter very wide but narrowing towards scutellary border; *scutellary border*, wider than humeral border, confluent with wide basal border and narrow sutural border; *costæ*, 9, round, granulate, equal in width across middle of disc, uniformly tapering to apex, explanate towards base; *striæ*, impunctate, deep near apex, evanescent towards base, the 4th stria irregularly and suddenly diverging towards the 3rd before reaching the base.

Convexity.—Moderately high.

Illustrations.—Fig. 23 (Spec. 243*a* × 15) shows the uniformity of the elytron both in shape and ornamentation, and Fig. 23*a* (part of Spec. 243*a* × 25) illustrates the regularly rounded costæ with the deep striæ.

Observations.—This *very large* species much resembles *Ademosyne Cameroni* and may be compared with *Ademosyne congener*, references to both of which are made under the heading of the former species.

Type.—Spec. 243*a* (cast); Fig. 23, plate 3. (G.S.Q. Coll.)
Type-counterpart.—Spec. 243*b* (mould). B. D. Coll.

ADEMOSYNOIDES MAGNIFICA, *sp. nov.*

Figs. 27, 28, plate 3.

THORAX.—

Metasternum.—Depth less than half the width; anterior margin slightly longer than the posterior, the former margin strongly sinuate behind coxal cavities; the posterior margin nearly straight, with the coxal piece adjacent to the metasternum distinct and narrow, although irregularly shaped; indistinct central suture joining anterior and posterior margins; surface of disc finely punctate generally, somewhat coarser punctæ on central anterior area.

Metasternal Episternum.—Sides nearly parallel, extends the full length of metasternum; finely punctate. Epimeron, narrow and short, but distinct. Mesosternal Episternum.—Outline quite pronounced, with a conspicuous projection towards contiguous coxa, surface finely granulate. Coxæ.—Intermediate coxæ as far apart as half the total width of metasternum; posterior coxal impressions apparently much closer together than the intermediate coxal impressions.

ABDOMEN.—

Segments.—Basal segment longer at the sides than at the centre, second segment shorter than basal, third and apical (propygidium and pygidium) equally longer than the basal and second; segments altogether forming a dome, whose diameter is about one and a-half times the length, and having a margin unbroken by indentations.

ELYTRON.—

Size.—*Length,* 8·5 mm.; *width,* 2·9 mm.

Outline.—*Apex,* obtusely pointed; *base,* round; *sutural margin,* gently curvate; *lateral margin,* strongly curvate; *scutellary* and *humeral margins,* equally round and confluent with base and adjoining margins; *general outline,* elongate-ovate.

Ornamentation.—*Sutural border,* as wide as adjacent costæ, somewhat pronounced; *lateral border,* narrow; *scutellary border,* wide, confluent with base and sutural border; *humeral border,* moderately narrow, confluent with base and lateral border; *costæ,* about 10, indistinct, explanate, finely granulate, narrower on sides than on centre, slightly converge from middle to base, convergence more pronounced from middle to apex; *striæ,* faint, impunctate.

Convexity.—Moderately high.

Illustrations.—Figs. 27, 28 (Specs. 199*a*, 199*b* × 10) together form the most complete specimen yet discovered. After it was split in two the impressions were found to be covered by a film of matrix representing the interior of the body, on removing which the sculpturing was revealed. What is now shown in Fig. 27 (the cast) is a part of the under surface of the elytra and the ventral view of the body, while Fig. 28 (the mould) represents the impression of the upper surface of the elytron fitting on to the *right* side of Fig. 27. The section shown in Fig. 28*a* illustrates the character of the costæ and the well-defined impunctate striæ.

Observations.—This *splendid* species has much in common with *Polysitum punctatus* so far as the body characters are concerned, and no doubt exists about the resemblance of the two genera, so much so that at first it was thought necessary to remove it from *Ademosyne* and place it with *Polysitum*. This would cause confusion regarding some of the other species of *Ademosyne* and would necessitate a considerably amended diagnosis of the genus, which, in any case, will probably be necessary later on. The elytron somewhat resembles *A. abnormis*, but is proportionately narrower than that species, and the costæ is not round, neither are the striæ distinct nor deep.

Type and Counterpart.—Specs. 199*a*, 199*b* (cast and mould); Figs. 27, 28, plate 3. (G.S.Q. Coll.)

Genus PLATYCROSSOS, gen. nov.

Genotype, *Platycrossos tumidus* (Tillyard).

There are a number of forms of elytra which have certain characters belonging to *Ademosyne* or *Ademosynoides*, such as defined striæ and costæ, but which, unlike those genera, have pronounced lateral or humeral borders, and *Platycrossos* has been created for their reception.

Three species have been placed in the genus, including the one previously described as *Ademosyne tumida*, Tillyard, all having a rather wide or very wide lateral border, and with or without a porrect or extended humeral area and border. The sizes vary from 2·9 mm. in length (as in *P. ligulatus*) to 6·2 mm. in length (as in *P. tumidus*), all three species being striate and all being more or less finely punctate. [Ety. *platys*, broad; *crossos*, a border.]

PLATYCROSSOS LIGULATUS, *gen. et sp. nov.*

Fig. 22, plate 3.

ELYTRON.—

Size.—*Length,* 2·9 mm.; *width,* 1·2 mm.

Outline.—*Apex,* very obtusely pointed; *base,* long, slightly curvate; *sutural margin,* gently arcuate from scutellum to apex; *scutellary margin,* curvate, long, confluent with sutural margin and base; *lateral margin,* strongly curvate, rectangularly joins the sutural margin at apex; *humeral margin,* short, confluent with base and sutural margin; *general outline,* ovate.

Ornamentation.—*Sutural border,* very narrow, widening along the scutellum, then merging into the *basal border,* the latter further widening and reaching its maximum width at the junction of the humeral border. The sides of the *humeral border* are parallel and far distant, and in merging into the *lateral border* the same width is maintained, which continues as far as the posterior margin, from thence becoming somewhat narrower to the apical point; *costæ,* 8 or 9, smooth, slightly raised, very faint, evanescent towards base; *striæ,* indistinct, with traces of punctæ.

Convexity.—Generally high, between the posterior lateral border and the apex very high.

Illustrations.—Fig. 22 (Spec. 268*a* × 30) shows the parallel-sided strap-shaped lateral border, the obscure costæ and striæ, and the pronounced apical convexity. Fig. 22*a* (part of Spec. 268*a* × 45) is an enlarged section of the posterior lateral margin illustrating the wide border with its well-marked inside edge and the faint costæ and punctate-striæ.

Observations.—This form with the *strap-bound* elytra has the tumid appearance of the other species of this genus, but has not the porrect shoulders nor the pronounced costal development of *P. tumidus* and *P. sub-tumidus.*

Type.—Spec. 268*a* (cast); Fig. 22, plate 3. Type-counterpart.—Spec. 268*b* (fragment). (G.S.Q. Coll.) Para-types.—Specs. 118*a–b.* (B. D. Coll.)

PLATYCROSSOS TUMIDUS (Tillyard).

Fig. 21, plate 3.

Ademosyne tumida, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length*, 6·2 mm.; *width*, 2·5 mm.

Outline.—*Apex*, very obtusely rounded; *base*, very long, nearly straight; *sutural margin*, gently curvate; *scutellary margin*, evidently short, obtusely angulated with base and confluent with sutural margin; *humeral margin*, porrect, obtusely angulated with base, confluent with *lateral margin*, the latter strongly and uniformly curvate to junction of sutural margin at apex; *general outline*, ovate.

Ornamentation.—*Sutural border*, evidently very narrow; *humeral border*, very wide, narrowing rapidly towards base, confluent with a very wide, explanate *lateral border*, the latter about equal in width to the costæ near the middle, and slightly narrowing at the posterior margin and around the apex; *costæ*, 9, finely granulate, somewhat explanate near base, round near apex. One short costa near centre of disc lies between two others which anastomose near apex; the ends of all costæ near apex being extended and faintly impressed across the wide apical border; *striæ*, faint near base, deep towards apex, in places punctate.

Convexity.—Very high, with very marked apical declivity.

Illustrations.—Fig. 21 (Spec. 45*b* × 12) shows the tumid appearance of the elytra, the two branching or ramose costæ, and the wide lateral border. Fig. 21*a* (part of Spec. 45*b* × 25) illustrates a section of the costæ, and a portion of the striæ where the punctæ are present, and also where they have been obliterated—or have not existed.

Observations.—This species is a conspicuous one on account of its *tumid* appearance, well-developed costæ, extreme fineness of punctæ, and wide lateral border. Resembles *P. sub-tumidus* in many ways, but that species is much smaller, has no punctate striæ or ramose costæ.

Type.—Spec. 45*b* (cast); Fig. 21, plate 3. (G.S.Q. Coll.)
Type-counterpart.—Spec. 45*a* (mould). B. D. Coll.

PLATYCROSSOS SUB-TUMIDUS, *sp. nov.*

ELYTRON.— Fig. 24, plate 3.

Size.—*Length*, 3 mm.; *width*, 1·6 mm.

Outline.—*Apex*, very obtusely rounded; *base*, straight, almost as wide as maximum width of elytron; *sutural margin*,

strongly and uniformly curvate (almost arcuate) from base to the round apex, where it is confluent with *lateral margin,* the latter curvate from apex to posterior margin, then straight to humerus, where it joins base at almost a right angle; *general outline,* elongate-cupolate.

Ornamentation.—*Sutural border,* not observed; *lateral border,* narrow near apex, rapidly widening anteriorly to the width of costæ and becoming parallel-sided with a faint median depression, towards humeral margin further widening to about one-quarter the length of the base where it junctions with an irregular but wide basal border; *costæ,* 10, round, equal in width, finely granulate. From middle to apex converging conformably with margins and lateral border, from middle to base all nearly parallel with one another, except the one adjacent to humeral border which converges rapidly to junction of humeral and basal borders; *striæ,* regular, gently curvate, finely punctate at intervals.

Convexity.—Moderately high.

Illustrations.—Fig. 24 (Spec. 171 × 30) shows the large development of the lateral border, the long base, and the swollen disc. Fig. 24*a* (part of Spec. 171 × 50) is a section showing the punctate striæ and the uniformly round costæ.

Observations.—Closely resembles the elytron of *P. tumidus* in outline and rotundity, but is *subordinate* to it in size, while the costal arrangement is different. *Ademosyne lata* has somewhat similar costæ and also a porrect humerus, but varies from this species in size, striæ, and in the shape of the sutural border.

Type.—Spec. 171 (mould); Fig. 24, plate 3. (G.S.Q. Coll.)

Genus SIMMONDSIA, *gen. nov.*

Genotype, *Simmondsia sub-piriformis,* sp. nov.

This new genus is separable from all others in having the elytra very conspicuously ornamented with a number of longitudinal ridges and connecting cross-bars, and in having depressions or alveolæ in the squares formed by the intersection of the two sets of elevations. In the two species described below, the lateral and sutural borders are well-defined and narrow, and the long scutellary margin is a conspicuous feature. One of the species, *S. sub-piriformis,* resembles some species of *Ademosyne* in outline, and in this respect may also be compared to forms belonging to *Elaterites,* but the alveolate structure is sufficient for identification purposes.

The genus is named after Mr. J. H. Simmonds, whose explorations many years ago at Denmark Hill resulted in the finding of the first fossil insects in that locality.

SIMMONDSIA SUB-PIRIFORMIS, *gen. et sp. nov.*

Fig. 34, plate 4.

ELYTRON.—

Size.—*Length,* 3 mm.; *width,* 1·2 mm.

Outline.—*Apex,* acutely round; *base,* short, slightly curvate; *humeral margin,* round, nearly as long as base, confluent with base and *lateral margin,* the latter strongly arcuate from humerus to apex; *sutural margin,* gently arcuate from apex to scutellary margin, confluent with the latter; *scutellary margin,* very long, greater than length of base, forming with the latter a rather obtuse angle; *general outline,* naviculate-ovate.

Ornamentation.—*Sutural border,* somewhat narrow; *scutellary border,* very narrow; *lateral border,* wider than sutural; *humeral border,* wider than lateral, with which it is confluent; *costæ,* 8, very narrow, sharply defined, very regularly spaced, all converge to apex more or less regularly from about the middle of disc, while to base all converge irregularly; those near centre curvate in the basal quarter; one adjacent to lateral border bifurcating before reaching humeral border. An alveolate structure is produced by narrow bars crossing all costæ, the honey-combed effect being pronounced on the sutural side of the disc, and evanescent towards lateral side, apex and base.

Convexity.—Moderately low.

Illustrations.—Fig. 34 (Spec. 135 × 30) shows rather too decidedly the alveolate cavities on the disc, which are not deep except in a few instances. Fig. 34*a* (part of Spec. 135 × 50) is a section showing costæ, cross-bars, and a few of the alveolæ with central scars or pits.

Observations.—The only species comparable with this *somewhat pear-shaped* species is *S. cylindrica,* which has a somewhat similar alveolate structure, but is distinguished from that species by its irregular and less pronounced costæ and cross-bars and by its somewhat naviculate outline. It has also some resemblance, in its disc sculpture, to *Mesothoris clathrata* and *Mesothoris tenuiclathrata.*

Type.—Spec. 135 (cast); Fig. 34, plate 4. (G.S.Q. Coll.)
Paratype.—Spec. 276 (cast). B. D. Coll.

SIMMONDSIA CYLINDRICA, *sp. nov.*

Fig. 29, plate 4.

ELYTRON.—

SIZE.—*Length,* 3 mm.; restored length 5 (?) mm.; *width,* 1·4 mm.

OUTLINE.—*Apex,* unknown; *base,* long, straight; *humeral margin,* short, curvate, confluent with base and *lateral margin,* the latter nearly straight; *scutellary margin,* straight, very long, greater than length of base, forms an obtuse angle with the latter; *sutural margin,* straight, very obtusely angulated with scutellary margin; *general outline,* cylindraceous.

ORNAMENTATION.—*All borders,* about equal in width to costæ; very narrow, sharply defined; *costæ,* 8, very narrow, subparallel, the fourth merging at scutellary-basal angle into oval hump, the eighth bifurcating near anterior lateral margin and becoming evanescent towards base; cross-bars formed between all costæ, those between the first three further apart than those on other parts of the disc, generally producing a deep grating with circular pits on the sutural side and a less pronounced and somewhat oblong grating on the central, lateral, and basal portions.

CONVEXITY.—Low on lateral three-quarters, depressed on sutural quarter.

ILLUSTRATIONS.—Fig. 29 (Spec. 87*a* × 20) shows the cylindraceous outline and the grating or latticed sculpturing of the disc, and Fig. 29*a* (part of Spec. 87*a* × 40) illustrates the elongated cavities, costæ and bars on the lateral half.

OBSERVATIONS.—This *cylinder-like* species has some resemblance to *Mesothoris grandis* in its disc ornamentation, but otherwise cannot be compared with that form. Its difference from *S. sub-piriformis* is given under the heading of that species.

TYPE.—Spec. 87*a* (cast); Fig. 29, plate 4. (G.S.Q. Coll.)
TYPE-COUNTERPART.—Spec. 87*b* (mould). B. D. Coll.

Genus GRAMMOSITUM, *gen. nov.*

Genotype, *Grammositum bilineatus,* sp. nov.

The outline of the elytron of the only species of this genus so far discovered suggests affinities with *Ademosyne,* although no form of the latter has been observed with so blunt an apex. The general appearance of the disc, however, in being covered

with elongated granules, oriented longitudinally, and in having only two rows of striæ, warrants its separation from that genus. The long basal margin of the elytron and its somewhat extended humerus are other noticeable characters. [Ety. *gramme,* a line; *sitos,* a grain.]

GRAMMOSITUM BILINEATUS, *gen. et sp. nov.*

Fig. 35, plate 4.

ELYTRON.—

Size.—*Length,* 2·5 mm.; *width,* 0·8 mm.

Outline.—*Apex,* wide, round; *base,* long, straight; *sutural* and *lateral margins,* almost equally and gently arcuate from base to the round apex; *humeral margin*(?) round, confluent with base and lateral margin; *general outline,* elongate-ovate.

Ornamentation.—*Borders,* lateral, apical and sutural very narrow, together forming one continuous curve around disc from humerus to scutellum; *disc,* ornamented on the sutural half with two slightly curvate, obscurely punctate lines approximately parallel with one another and with the sutural margin, these lines evanescing towards both base and apex; *surface,* covered with elongate-ovate granules, with traces of a few irregular longitudinal striæ.

Convexity.—Low.

Illustrations.—Fig. 35 (Spec. 136*a* × 30) shows the arrangement of the two ill-defined lines on the elongated oval disc, and Fig. 35*a* (part of Spec. 136*a* × 50) illustrates the details of the punctæ on the lines in association with the elongate-granular sculpture.

Observations.—No connection can be established between this form with the *two lines* and any others amongst all those discovered at Ipswich, and only one specimen so far has been found.

Type.—Spec. 136*a* (mould); Fig. 35, plate 4. (G.S.Q. Coll.)
Type-counterpart.—Spec. 136*b* (cast). B. D. Coll.

Genus SHEPHERDIA, *gen. nov.*

Genotype, *Shepherdia quadrivittata,* sp. nov.

The one species of this genus has a slight resemblance to some of the *Ademosyne* in form, but none of the latter have the

banded or vittate sculpture of the elytron. The fine cross-lining or strigose structure is also a unique feature amongst the Ipswich beetles. The genus is named after Mr. S. R. L. Shepherd who devoted considerable time and attention to the exploratory work at Ipswich, and who unearthed a number of the forms herein described.

SHEPHERDIA QUADRIVITTATA, *gen. et sp. nov.*

Fig. 32, plate 4.

ELYTRON.—

Size.—*Length,* 11 mm.; *width,* 3·4 mm.

Outline.—*Apex,* acutely rounded; *base,* long, regularly curvate; *scutellary margin,* curvate, confluent with base; *sutural margin,* slightly arcuate, confluent with scutellary margin and with narrow *apical margin,* the latter confluent with lateral margin; *lateral margin,* moderately arcuate from apex to *humeral margin; general outline,* basal half cylindraceous, apical half elongate-coniform.

Ornamentation.—*All borders,* equally narrow and, except humeral, all confluent with one another, an irregularity—possibly accidental—existing at the junction of the humeral with the lateral border; *vittæ,* 4, as narrow as the borders, explanate, evanescent towards base, the first one branching from posterior sutural border and extending obliquely towards middle of base, second one branching from apex and extending to humeral-basal border, third somewhat obscurely begins at apex and extends to humerus, fourth is parallel to lateral border, is somewhat obscure near apex, and extends to the junction of the lateral-humeral border. Another narrow vittate structure lies along the anterior sutural border, of which it might be portion; *disc,* surface laterally rugulose, and longitudinally strigose between vittæ, this finely wrinkled sculpture being evanescent near the apex and also over the basal portion.

Convexity.—Low all over the surface of disc.

Illustrations.—Fig. 32 (Spec. 130*a* × 8) shows the general arrangement of the ornamentation, and Fig. 32*a* (part of Spec. 130*a* × 15) indicates the character of the finely wrinkled and streaked surface between three of the narrow strap-shaped bands.

Observations.—This *four-banded* species may be compared with forms belonging to *Tillyardiopsis* for general outline, but there the resemblance ceases. Otherwise, in its sculpture and size, together with its low convexity, there is no form of beetle found at Ipswich with which to compare it.

Type.—Spec. 130*a* (cast); Fig. 32, plate 4. (G.S.Q. Coll.)
Type-counterpart.—Spec. 130*b* (mould). B. D. Coll.

Genus POLYSITUM, *gen. nov.*

Genotype *Polysitum punctatus*, sp. nov.

This genus is instituted for the reception of two species having somewhat broadly ovate elytra. Undoubtedly, it is closely allied to *Ademosyne*, as shown by the preserved thoracic and abdominal structures, but the ornamentation of the elytra is quite different from the latter genus in being uniformly granulate instead of striate-costate. [Ety. *polys*, many; *sitos*, a grain.]

POLYSITUM PUNCTATUS, *gen. et sp. nov.*

Figs. 36, 37, plate 4.

THORAX.—

Metasternum.—Width, about double the average depth; *anterior margin*, slightly narrower than posterior margin with strongly sinuate depressions posterior to intermediate coxal cavities; *posterior margin*, curvate slightly from sides to centre, with coxal piece narrow and irregular; distinct central suture joining posterior and anterior margins; surface of disc finely and uniformly punctate.

Metasternal Episternum.—Sides nearly parallel, extending the full length of metasternum, and connected with coxal pieces posterior to metasternum; punctæ similar to those on metasternum. Epimeron, indistinct, curved, narrow, and short. Mesosternal Episternum on left side (of Fig. 37) rhomboidal, depressed but well-defined, on right side obliterated; punctæ as on metasternum. Coxæ.—Distance between intermediate coxal cavities apparently less than half the width of the metasternum, but definition not clear; posterior cavities apparently as far apart as intermediate cavities.

ABDOMEN.—

Segments.—Basal, second, and third segments equal to one another in length, the first two almost equal in width; pygidium

not well preserved but apparently the longest of the segments; the four segments together forming a dome without irregularities, the lateral diameter being about 1½ times that of the total length.

ELYTRON.—

Size.—*Length,* 6·9 mm.; *width,* 2·7 mm.

Outline.—*Apex,* obtusely round; *base,* long, semicircular; *scutellary margin,* short, confluent with round base and with *sutural margin,* the latter straight as far as the middle, then slightly curvate to round apex; *lateral margin,* strongly arcuate from apex to *humeral margin,* with which it is confluent, the latter margin being confluent with the base; *general outline,* ovate, slightly more rotundate on lateral margin than on sutural.

Ornamentation.—Surface of disc finely and uniformly punctate, without any other sculpture, and apparently with narrow lateral and sutural borders.

Convexity.—Generally low, with a tendency to become moderately high in the humeral area.

Illustrations.—Fig. 37 (Spec. 153*b* × 12) shows the thoracic and abdominal features and the under surface of the lateral portions of the elytra. Fig. 36 (Spec. 153*a* × 12) illustrates the upper surface of the elytron corresponding with the right side of Fig. 37, of which Fig. 36*a* is an enlargement (× 40).

Observations.—This species with the *punctate* ornamentation has many thoracic and abdominal characters in common with *Ademosynoides magnifica* but in the shape and ornamentation of the elytra the two are quite dissimilar. The thoraces are almost identical and are considered to be very indicative of their Hydrophilidæ affinities. The coxal cavities are less pronounced (or perhaps not so well preserved) than in *A. magnifica,* and this remark would also apply to other thoracic structures. The abdomina are much alike, but the elytra do not project beyond the pygidium, which constitutes a very pronounced difference. The elytral characters, which are not those recognised as belonging to *Ademosyne* in being without borders, costæ, and striæ, resemble those of *Polysitum minutus,* from which they are distinguished in being punctate instead of granular and in having a less arcuate lateral margin, besides having minor differences in shape.

Type.—Spec. 153*b* (cast); Fig. 37, plate 4; Type-counterpart.—153*a* (mould); Fig. 36, plate 4. (G.S.Q. Coll.)

POLYSITUM MINUTUS, *sp. nov.*

Fig. 25, plate 3.

ELYTRON.—

SIZE.—*Length,* 2·2 mm.; *width,* 1·2 mm.

OUTLINE.—*Apex,* obtusely round; *base,* wide, slightly and irregularly curvate; *humeral margin,* obtusely angulated with base and *lateral margin,* the latter strongly arcuate to apex; *sutural margin,* gently arcuate from apex to scutellary margin, the latter round and confluent with sutural margin and base; *general outline,* ovate-cordate.

ORNAMENTATION.—*Borders* very indistinct, lateral, apical and sutural apparently narrow, basal and humeral wide; *vittæ,* few, indistinct, shallow, irregularly distributed over disc; *surface,* finely granulate.

CONVEXITY.—Moderately high all over disc.

ILLUSTRATIONS.—Fig. 25 (Spec. 336*a* × 30) shows the general outline of the elytron and its inornate surface, and Fig. 25*a* (part of Spec. 336*a* × 50) illustrates a portion of the finely granulate disc ornamented with two indistinct longitudinal strap-like impressions.

OBSERVATIONS.—This *very small* species is comparable with *P. punctatus* (which see for notes) and *Leioodes planum,* the latter somewhat resembling it in size and disc ornamentation, but differing from it in its borders and shape.

TYPE.—Spec. 336*a* (cast); Fig. 25, plate 3. TYPE-COUNTERPART.—Spec. 336*b* (mould). (G.S.Q. Coll.)

Fam. **TENEBRIONIDÆ** (?).

Genus ULOMITES, Tillyard.

Genotype, *Ulomites Willcoxi,* Tillyard.

Since the discovery of the genotype specimen only one other individual has been found, and that distorted, and no further details regarding generic characters have been brought to light.

The genus, according to Dr. Tillyard, "appears to be closely allied to the recent Australian genus *Uloma,* with which it agrees very closely in the sculpture and shape of the elytra." The distorted individual has been compressed laterally, but regularly, in which condition it bears so close a resemblance to

some forms of the Elateridæ that an opinion has been expressed that it should be placed in that family, but the type and the distorted specimen undoubtedly belong to the same species.

In comparison with other genera no difficulty is experienced in distinguishing it, with its large size, elongated shape, acuminated apex, and the very wide and pronounced costa adjacent to the lateral border.

ULOMITES WILLCOXI, *Tillyard.*

Fig. 33, plate 4.

Ulomites Willcoxi, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length,* 11 mm.; *width,* 3 mm.

Outline.—*Apex,* acutely pointed; *base,* long, slightly curvate; *scutellary margin,* long, forms obtuse angle with base, confluent with *sutural margin,* the latter very gently arcuate to apical point; *lateral margin,* arcuate from base to middle, then gently curvate to *humeral margin,* with which it is confluent, the latter being sub-angulate at its junction with the base; *general outline,* basal two-thirds cylindraceous, apical one-third elongate-subconiform.

Ornamentation.—*Scutellary border,* narrow-cuneate, the apex of which is confluent with the *sutural border,* the latter being narrow near scutellum, becoming gradually wider towards apex, where it is striolate; *lateral border,* very narrow but well defined on posterior margin and about the middle, evanescent both apically and basally; *costæ,* 8, faintly granulate, the first four of equal width near middle and slightly converging from base and becoming evanescent towards apex; 5th and 6th slightly wider and almost parallel near the middle of disc, coalescing and abruptly ending before reaching the apex, while at the other end before reaching the base it curves slightly towards humerus; 7th equal in width to and parallel with the 6th, and extending from basal humeral angle to the extreme posterior lateral margin and apex. All costæ except the 8th somewhat low, the 8th being wide, round, and prominent. *Striæ,* distinct, all punctate, one forming the inside edge of the sutural border, another traversing the large 8th costa from humeral margin to apical point, while the 4th, 5th, and 6th striæ form the boundary of the two short central costæ.

Convexity.—Low, except on lateral side, where the 8th costa is prominently developed.

Illustrations.—Fig. 33 (Spec. 50*b* × 10) shows the cuneate scutellary piece, and the very wide punctate costæ on the lateral side. Fig. 33*a* (part of Spec. 50*b* × 25) is a section showing the large costa, adjacent striæ, and the widely separated punctæ.

Observations.—This species has no parallel amongst those found at Ipswich, and is one of the exceedingly rare forms.

Type.—Spec. 50*b* (cast); Fig. 33, plate 4. (G.S.Q. Coll.)
Type-counterpart.—Spec. 50*a* (mould). B. D. Coll.

Fam. **ELATERIDÆ.**

Genus ELATERITES, Heer.

Dr. Tillyard's diagnosis of this genus is as follows:—"Elytron elongate, oval, tapering posteriorly, closely resembling that of the recent 'click' beetle, no definite sculpture visible except a slight roughness of the surface." This will require to be modified to some extent, as the two forms of elytra now included are either costate-strigose or granulate-fluctuose. *E. transversus* has well-marked narrow costæ, with transverse strigæ, and *E. subulatus* has the disc surface ornamented with transversely elongated granules arranged in fluctuose or wavy lines.

ELATERITES SUBULATUS, *sp. nov.*

Fig. 31, plate 4.

ELYTRON.—

Size.—*Length,* 4·3 mm.; *width,* 2 mm.

Outline.—*Apex,* acute (?); *base,* round, very long; *sutural* and *lateral margins,* equally and moderately arcuate, respectively confluent with *scutellary* and *humeral margins,* both the latter being round and confluent with base; *general outline,* subulate.

Ornamentation.—*Sutural* and *lateral borders,* moderately narrow, nearly equal in width, both confluent with *basal border,* which is somewhat irregular, and both parallel-sided; *disc,* surface sculpture minutely fluctuate-granulate without other ornamentation.

Convexity.—High around basal portions, still more pronounced towards apex.

Illustrations.—Fig. 31 (Spec. 263*b* × 20) shows the apical half with the minute wavy structure, the basal half, however, being similarly ornamented. Fig. 31*a* (part of Spec. 263*b* × 50) illustrates the microscopic structure of the surface of the disc.

Observations.—This *awl-shaped* form of elytron has some resemblance to the elytra of *Etheridgea australis* in its outline, but no other species has the same disc granulation except perhaps *Grammositum bilineatus,* which, however, has the granules elongated longitudinally, while in this species they are mostly elongated laterally.

Type.—Spec. 263*b* (cast); Fig. 31, plate 4. (G.S.Q. Coll.)
Type-counterpart.—Spec. 263*a* (mould). B. D. Coll.

ELATERITES TRANSVERSUS, *sp. nov.*

Fig. 30, plate 4.

ELYTRON.—

Size.—*Length,* 6·5 mm.; *width,* 2·7 mm.

Outline.—*Apex,* acutely rounded; *base,* very long; slightly curvate; *humeral margin,* round, confluent with base and *lateral margin,* the latter moderately arcuate to apex; *scutellary margin,* obtusely sub-angulated with base and *lateral margin,* the latter moderately curvate to apex; *general outline,* subulate-ovate.

Ornamentation.—*Basal border,* wide, irregular, confluent with the somewhat wide and round *humeral border,* the latter confluent with the moderately narrow *lateral border; sutural border,* moderately narrow, becoming evanescent towards the apex; *costæ,* 5, very narrow, carinate, irregularly spaced from one another, and all irregularly converging from base to apex. The two central and wide intercostal spaces are punctate-striate, the striæ converging towards apex, before reaching which they develop into subsidiary costæ, altogether making, in the apical quarter, about 9 low, converging, evanescent costæ; surface of intercostal spaces transversely rugulose, portions being covered with a *pile* having elongate-clathrate depressions.

Convexity.—Basal half of disc is moderately high, apical half very high.

Illustrations.—Fig. 30 (Spec. 159*b* × 12) shows the abnormally high convexity of the central portion of the apical quarter, and also shows the general arrangement of the costal and transversely rugose sculpturing. Fig. 30*a* (part of Spec. 159*b* × 25) illustrates the character of the rugæ between the striæ, and of the pile covering this structure.

Observations.—This *transversely* wrinkled species has no resemblance to any other form so far as sculpture is concerned, but is comparable with *E. subulatus* in shape and borders.

Type.—Spec. 159A (cast); Fig. 30, plate 4. (G.S.Q. Coll.)
Type-counterpart.—Spec. 159*a* (mould). B. D. Coll.

Genus ELATERIUM, Westwood.

Handlirsch has a number of forms of elytra placed in this genus, but offers no diagnosis of their general characteristics. The forms now included, admittedly on doubtful grounds, are *E. bipunctatum* and *E. punctomarginum*, both having somewhat elongated discs with parallel costæ, the former also having double lines of punctate striæ, and the latter a very wide lateral border centrally ornamented with minute groups of punctæ. All the species are quite unlike any of the other forms found at Ipswich.

ELATERIUM PUNCTOMARGINUM, *sp. nov.*

Fig. 43, plate 5.

ELYTRON.—

Size.—*Length*, 7 mm.; *width*, 2·2 mm.

Outline.—*Apex*, acutely pointed; *base*, unknown; *sutural* and *lateral margins*, straight near middle, arcuate towards apex; *general outline*, cylindraceous about middle of elytron, subconiform towards apex.

Ornamentation.—*Sutural* (?) *border*, uniformly narrow to apical point; *lateral* (?) *border*, parallel-sided, three times the width of sutural border, extends without narrowing to the apex where it anastamoses with sutural border, deeply grooved along inside edge and pitted along centre, each of the pits consisting of a group of small punctæ; *disc*, covered with nine pitted equidistant striæ, parallel with one another about the middle, and converging evanescently to apex, the pits being composed of a number of punctæ and of smaller size than those along the centre of the lateral border.

Convexity.—Moderately and uniformly high.

Illustrations.—Fig. 43 (Spec. 200*b* × 12) shows the cylindraceous middle portion of the elytron, the sub-coniform apex, and the pitted border. Fig. 43*a* (part of Spec. 200*b* × 25) is a section of the posterior area showing the large groups of punctæ on the border, the adjacent deep groove, and the smaller groups of punctæ on the surface of the disc.

Observations.—The species is quite distinct from any other in disc and border sculpture, but its general structure suggests its belonging to the Elateridæ. It is different from *E. bipunctatum* in its wide *punctate border* and its disc ornamentation, besides being more decidedly cylindraceous.

Type.—Spec. 200*b* (cast); Fig. 43, plate 5. (G.S.Q. Coll.)
Type-counterpart.—Spec. 200*a* (mould). B. D. Coll.

ELATERIUM BIPUNCTATUM, *sp. nov.*

Fig. 46, plate 5.

ELYTRON.—

Size.—*Length,* 4·4 mm.; *width,* 1·4 mm.

Outline.—*Apex,* acutely pointed; *base,* unknown; *sutural* and *lateral margins,* arcuate, the latter the more pronounced of the two; *general outline,* naviculate.

Ornamentation.—*Sutural border,* narrow from the scutellum (?) to apex; *lateral border,* wider than sutural, rather wide near humerus (?), narrower towards middle and apex; *costæ,* 8, narrow, carinate, nearly parallel, nearly equidistant, slightly converging both towards base and apex from middle, in the latter case some of the costæ joining posterior sutural and lateral margins and not quite reaching the apex; intervals, wide, with two lines of punctæ, some of the lines in places being indistinct and evanescent.

Convexity.—Central portion high, somewhat declivous at the sides and apex.

Illustrations.—Fig. 46 (Spec. 292*a* × 20) shows the general arrangement of the costæ and punctate intervals, and the slight variations in the width of the borders. Fig. 46*a* (part of Spec. 292*a* × 40) illustrates the narrow costæ and the somewhat irregular double line of punctæ.

Observations.—The shape and punctures resemble other forms in this family, but otherwise the species is quite unlike any other so far unearthed in the Denmark Hill Quarry. Reference is made to its slight resemblance to *E. punctomarginum* under the heading of that species.

Type.—Spec. 292*a* (cast); Fig. 46, plate 5. (G.S.Q. Coll.)
Type-counterpart.—Spec. 292*b* (mould). B. D. Coll.

Fam. **DERMESTIDÆ** (?).

Genus REEVEANA *gen. nov.*

Genotype *Reeveana minor*, sp. nov.

Three species are included in this new genus, all characterised by simplicity of ornamentation. They all have rather wide lateral borders, and all are more or less tapered apically from near the base, the shape of the elytra being either cuneate or subulate. *R. major* is concentrically marked, *R. intermedia* is marked only parallel to the sides, while *R. minor* is inornate. In shape and border design this genus is comparable with *Simmondsia*, but its disc ornamentation is a distinguishing feature. The genus is named in honour of Mr. W. H. Reeve of the Geological Survey, who has been associated with the author in the making of the numerous drawings of the fossil elytra.

REEVEANA MAJOR, *gen. et sp. nov.*

Fig. 38, plate 5.

ELYTRON.—

Size.—*Length*, 5·4 mm.; *width*, 1·9 mm.

Outline.—*Apex*, unknown; *base*, wide, round; *humeral* (?) and *scutellary margins*, round, confluent with base; *sutural* and *lateral margins*, uniformly and gently curvate from base to posterior margin; *general outline*, subulate-ovate.

Ornamentation.—*Basal*, *scutellary*, and *sutural* (?) *borders* confluent, and equally narrow; *humeral* and *lateral* (?) *borders*, confluent and equally wide, with a deep groove on the inside edge; *disc*, ornamented with two faint, complete and concentric vittæ, which begin near base, curve around apical quarter and return to base, a third short vittæ beginning near scutellum and coalescing with sutural border about middle; surface of disc otherwise smooth.

Convexity.—Borders explanate, well-defined; disc, somewhat low, evenly rounded.

Illustrations.—Fig. 38 (Spec. 251*a* × 15) shows the arrangement of the concentric straps on the disc and the character of the borders. Fig. 38*a* (part of Spec. 251*a* × 40) is a section across the narrow border showing its well-defined inside edge and the adjacent portion of the disc.

Observations.—This *large* species has been placed in the Dermestidæ at the suggestion of Mr. H. J. Carter, the Coleopterist of Sydney, who considers it has affinities to this family. It somewhat resembles *R. intermedia* in outline and border structure, but varies from that form in ornamentation and size.

Type.—Spec. 251*a* (cast); Fig. 38, plate 5. (G.S.Q. Coll.)
Type-counterpart.—Spec. 251*b* (mould). B.D. Coll.

REEVEANA INTERMEDIA, *sp. nov.*

Fig. 45, plate 5.

ELYTRON.—

Size.—*Length,* 3·6 m.m.; *width,* 1·4 mm.

Outline.—*Apex,* unknown; *base,* wide, slightly curvate; *humeral and scutellary margins,* equally round, each merging into base and contiguous margin; *sutural margin,* nearly straight; *lateral margin,* moderately arcuate; *general outline,* cuneate-ovate.

Ornamentation.—*Basal, humeral* and *lateral borders,* equally narrow and well-defined; *scutellary border,* wide and striolate; *sutural border,* slightly wider than lateral; *all borders,* well-defined; *striæ,* 4, the one near to and parallel with the sutural border being faint; three others, also faint, are parallel with lateral border; and a median one, very faint, exists on the basal half; *surface,* smooth.

Convexity.—Low.

Illustrations.—Fig. 45 (Spec. 201*b* × 15) shows the subcuneate form of the elytron, the well-defined borders, and the evanescent striæ. Fig. 45*a* (part of Spec. 201*b* × 40) is an enlargement showing the narrow lateral border and two of the indistinct striæ.

OBSERVATIONS.—The only form resembling *R. intermedia* is *R. major*, concerning which some notes are given under the heading of that species. Both elytra have obscure ornamentation, which might be natural or the result of *post mortem* disfigurement.

TYPE.—Spec. 201*b* (cast); Fig. 45, plate 5. (G.S.Q. Coll.)
TYPE-COUNTERPART.—Spec. 201*a* (mould). B. D. Coll.

REEVEANA MINOR, *sp. nov.*

Fig. 42, plate 5.

ELYTRON.—

SIZE.—*Length*, 3 mm.; *width*, 1 mm.

OUTLINE.—*Apex*, acutely pointed; *base*, wide, curvate; *humeral margin*, round, confluent with base and *lateral margin*, the latter gently arcuate to apex; *scutellary margin*, very long, sub-angulated with base and confluent with *sutural margin*, the latter moderately arcuate to base; *general outline*, subulate-ovate.

ORNAMENTATION.—*Basal, humeral* and *lateral borders*, all equally wide and confluent, the last mentioned being narrower near apex; *scutellary border*, narrow except where joining wide basal border, confluent with narrow *sutural border*, the latter uniform to apex; *disc*, inornate, lævigate, except at apex where traces of rugæ are observed.

CONVEXITY.—Borders explanate, disc uniformly and gently rotundate.

ILLUSTRATIONS.—Fig. 42 (Spec. 297*a* × 30) shows the uniformity in the awl-shaped outline and the absence of ornamentation on the disc. Fig. 42*a* (part of Spec. 297*b* × 50) illustrates the apical point where the wide lateral border merges into the narrow sutural one.

OBSERVATIONS.—This *small* species somewhat resembles *R. major* in shape and borders, but differs from it in ornamentation, size, and convexity. The species may also be compared with *Tillyardiopsis granulata*, but the differences are conspicuous in regard to size, shape, and borders.

TYPE.—Spec. 297*a* (cast); Fig. 42, plate 5. (G.S.Q. Coll.)
TYPE-COUNTERPART.—Spec. 297*b* (mould). B. D. Coll.

Genus TRYONIOPSIS, *gen. nov.*

Genotype *Tryoniopsis punctata,* sp. nov.

The explanate and attenuated form of this genus is its principal feature. The borders are narrow but well-defined, the costæ are low and the striæ shallow, the basal portions being wide and the apical portion tapered. The genus is distinguished from both *Ademosyne* and *Ademosynoides* in the elytron being attenuated, in having a low convexity, and in the borders being very narrow and sharply defined. *Ademosyne punctata* closely approaches *Tryoniopsis* in outline, and there is just the possibility that it should be included in this genus. The genus is named in honour of Mr. H. Tryon, entomologist, who kindly assisted the author in many ways in the preparation of this paper.

TRYONIOPSIS PUNCTATA, *sp. nov.*

Fig. 65, plate 7.

ELYTRON.—

Size.—Length, 6 mm.; width, 2·1 mm.

Outline.—*Apex,* acutely rounded; *base,* short (?), round (?); *sutural margin,* gently arcuate; *lateral margin,* moderately arcuate; *humeral margin,* apparently straight and sub-angulated with base and lateral margin; *general outline,* gently tapered from middle to base, rapidly tapered from middle to apex.

Ornamentation.—*Sutural* and *marginal borders,* very narrow but sharply defined; *costæ,* 10, sub-explanate, laterally rugulose, across the middle of disc unequal to one another in width, one short costa adjacent to scutellary margin, one evanescent and indistinct costa adjacent to lateral border, all others converging towards apex, some of which join lateral border near apex, all either straight or slightly curvate; *striæ,* shallow, finely punctate.

Convexity.—Low, slightly elevated near humeral margin.

Illustrations.—Fig. 65 (Spec. 250*a* × 12) shows the tapering feature of the elytron, the faint converging costæ, and the sharply defined borders. Fig. 65*a* (Spec. 250*a* × 25) illustrates the faintly punctate striæ and the finely wrinkled costæ.

Observations.—The species is comparable with *U. Willcoxi* in the shape of the apical half and somewhat in the shape of the humeral area, from which it varies, however, in costal characters and in its small size. It resembles *Tryoniopsis granulata* in its attenuated outline and converging costæ, but the basal portion is quite different in shape and the striæ are punctate.

Type.—Spec. 250*a* (cast); Fig. 65, plate 7. (G.S.Q. Coll.)
Type-counterpart.—Spec. 250*b* (mould). B. D. Coll.

TRYONIOPSIS GRANULATA, *sp. nov.*

Fig. 59, plate 7.

ELYTRON.—

Size.—*Length,* 5·7 mm.; *width,* 1·8 mm., but the dimensions are variable.

Outline.—*Apex,* acutely rounded; *base,* short, slightly curvate; *sutural (?) margin* slightly curvate from apex to scutellary margin; *scutellary (?) margin,* long, confluent with both base and sutural margin; *lateral margin,* gently curvate from humeral margin to apex, with a slightly more pronounced curve close to apex; *humeral (?) margin,* very long, pronounced, confluent with base, very obtusely angulate with lateral margin; *general outline,* the margins gently taper to apex from one quarter the length from base, and from the same position a rapid taper to base.

Ornamentation.— *Sutural border,* narrow, distinct; *lateral border,* slightly wider than sutural, has median stria on posterior portion; *humeral border,* narrow, confluent with base, obtusely angulate with lateral border; *costæ,* 10, smooth, explanate, somewhat unequal in width across disc at one-third the length from base, from which position all costæ regularly converge both to apex and base; *striæ,* impunctate, very faint near apex, very deep on basal quarter.

Convexity.—Low, almost explanate.

Illustrations.—Fig. 59 (Spec. 161*a* × 15) shows the deep striæ on the basal quarter and the faint striæ near the apex. Fig. 59*a* (part of Spec. 161*a* × 25) is a section near the apex illustrating the impunctate striæ and the dividing striæ on the border.

Observations.—The outline of this species, taken in conjunction with its gently converging and explanate costæ, separates it from all forms of *Ademosyne,* of which, perhaps, *Ademosyne punctata* comes nearest to it in shape and convexity. It closely resembles *T. punctata* in size, shape, and borders, but that species is found to be, after examining a number of specimens, persistently punctate.

Type.—Spec. 161*a* (cast); Fig. 59, plate 7. (G.S.Q. Coll.)
Type-counterpart.—Spec. 161*b* (mould). B. D. Coll.

Fam. **BUPRESTIDÆ** (?).

Genus LOBITES, *gen. nov.*

Genotype, *Lobites tuberculatus,* sp. nov.

This genus has been established for the reception of three pod-shaped elytra very probably belonging to the *Buprestidæ.* All the elytra have a bisinuate lateral margin and a very arcuate sutural margin. *L. tuberculatus* is the smallest species, and has well-marked lines of tubercles. *L. granulatus* is inornate, except for fine granulations, and *L. trivittatus,* the largest species, is ornamented with three simple narrow longitudinal bands. *Mesostigmodera* is the only other genus with which to compare *Lobites,* but size and ornamentation are distinguishing characters. [Ety.: *lobos,* a pod.]

LOBITES TRIVITTATUS, *gen. et sp. nov.*

Fig. 44, plate 5.

ELYTRON.—

Size.—*Length,* 12·5 mm.; *width,* 3·4 mm.

Outline.—*Apex,* acutely pointed; *base,* curvate, somewhat short; *sutural margin,* moderately arcuate from obtuse basal-scutellary angle to apex; *humeral margin,* round (?) and confluent with base and *lateral margin,* the latter nearly straight for two-thirds the length of elytron from the base, then moderately arcuate to apex; *general outline,* sub-cylindraceous for two-thirds the length from base, then sub-coniform to apex.

Ornamentation.—*Sutural border,* wide from base to apex with minute serræ between middle and apical end; *lateral border,* very narrow from base to apex; *disc,* ornamented with three narrow micro-granulate and somewhat irregular vittæ that

divide the disc into four longitudinal and sub-equal sections. The two outside vittæ become evanescent towards the base, converge and anastamose on the apical quarter and join sutural border near apical point, the central vittæ starting from base and vanishing on apical quarter; *surface* finely granulate. *Note.*—In the illustration of this species the type specimen is shown disfigured by cracks.

Convexity.—Moderately low.

Illustrations.—Fig. 44 (Spec. 164*a* × 8) shows the three irregular strap-shaped lines on the disc, together with other details of structure. Fig. 44*a* (part of Spec. 164*a* × 25) is a section across two of the vittæ.

Observations.—In shape and size this *three-banded* species resembles *Mesostigmodera typica*, but the borders, convexity, and ornamentation are quite different. In shape, but not in size or sculpture, it somewhat resembles *L. tuberculatus*, and in common with that species has an incision on the disc.

Type.—Spec. 164*a* (cast); Fig. 44, plate 5. (G.S.Q. Coll.)
Type-counterpart.—164*b* (mould). B.D. Coll.

LOBITES TUBERCULATUS, *sp. nov.*

Fig. 41, plate 5.

ELYTRON.—

Size.—*Length*, 5·8 mm.; *width*, 1·8 mm.

Outline.—*Apex*, obtusely pointed; *base*, somewhat short, curvate; *sutural* and *scutellary margins*, together moderately arcuate, the latter confluent with the base; *humeral margin*, subangulated with base and *lateral margin*, the latter bisinuate to the middle with the apical one-third strongly arcuate; *general outline*, fabiform.

Ornamentation.—*Scutellary border*, moderately wide and pronounced; *sutural border*, confluent with scutellary border and becoming narrow towards apex; *lateral border*, very narrow on basal half, widening on posterior margin and then narrowing to apex; *disc*, ornamented with four irregular and inequidistant lines of tubercles, which begin at base, become evanescent towards apex, and divide the disc into five longitudinal sections, intertubercular spaces being occupied by a varying number of lines of fine granulations. An incision is present on a line of tubercles at about the centre of the disc and is about half the width of the disc in length.

Convexity.—Somewhat high, with a protuberant ridge on humeral area which becomes evanescent on basal quarter.

Illustrations.—Fig. 41 (Spec. 342*a* × 15) shows the bean-shaped outline, the humeral protuberance, and the general design of the sculpture. Fig. 41*a* (part of Spec. 342*a* × 25) illustrates the closely compact tubercules on two of the lines, and also the granulated lines on the interstices.

Observations.—The fabiform outline of the elytron, taken in conjunction with the *tuberculated* and granulated surface lines, are means of distinguishing the species from other forms. It has a somewhat similar shape to *L. trivittatus* and *L. granulatus*, but differs from both in its characteristic ornamentation. It may also be compared with *Mesothoris clathrata* and *M. tenuiclathrata* in general appearance, but its microscopic structure is a distinguishing feature.

Type.—Spec. 342*a* (cast); Fig. 41, plate 5. Type-counterpart.—Spec. 342*b* (fragment of mould). (G.S.Q. Coll.)

LOBITES GRANULATUS *sp. nov.*

Fig. 40, plate 5.

ELYTRON.—

Size.—*Length*, 8·3 mm.; *width*, 3 mm.

Outline.—*Apex*, unknown; *base*, somewhat short, slightly curvate; *sutural* and *scutellary margins*, together arcuate from base to posterior margin; *humeral margin*, sub-angulated with base and *lateral margin*, the latter bisinuate; *general outline*, fabiform.

Ornamentation.—*Sutural* and *scutellary borders*, probably narrow; *lateral* and *humeral borders*, moderately wide, the former wide near middle and narrowing towards apex; *disc*, surface irregularly and coarsely granulate with two long, evanescent and irregular lines of punctæ (?) obliquely crossing middle, and a third one near anterior sutural border, all three sub-equidistant and sub-parallel; on the punctate line nearest the lateral border, and about the middle, an incision or a very short deeply-punctate stria is to be observed, and is associated with some adjacent irregularity which might be accidental.

Convexity.—Moderately high.

Illustrations.—Fig. 40 (Spec. 183*b* × 10) is a general view showing the shape and surface markings of the elytron, while Fig. 40*a* (part of Spec. 183*b* × 25) is a section showing an enlargement of the surface sculpture.

Observations.—The only form resembling this *granulated* species is the somewhat similarly shaped *L. tuberculatus,* which has the incision on the disc common to this genus but the surface ornamentation quite different. It may be compared with *Polysitum punctatus* and *Tillyardiopsis granulata* in its ornamentation, but otherwise there is no resemblance to either of these species.

Type.—Spec. 183*b* (mould); Fig. 40, plate 5. (G.S.Q. Coll.).
Type-counterpart.—Spec. 183*a* (cast). B. D. Coll.

Genus MESOSTIGMODERA, Handlirsch.

Genotype, *Mesostigmodera typica,* E. & O.

MESOSTIGMODERA TYPICA.

Fig. 39, plate 5.

Mesostigmodera typica, Tillyard. Mesozoic and Tertiary Insects of Queensland, &c. Queensland Geol, Surv. Pub. No. 253. Brisbane, 1916.

Mesostigmodera typica, Handlirsch. Die Fossilen Insekten. Leipzic, 1908.

Mesostigmodera typica, Etheridge and Olliff. Mem. Geol. Surv. N.S.W. Palæontology, No. 7. Sydney, 1890.

ELYTRON.—

Size.—*Length,* 15 mm.; *width,* 4·8 mm.

Outline.—*Apex,* obtusely pointed; *base,* wide, curvate; *humeral* and *scutellary margins,* subangulate; *sutural margin,* gently arcuate; *lateral margin,* nearly straight for two-thirds the length from base, then strongly arcuate to apex; *general outline,* sub-cylindraceous for two-thirds the length from base, then sub-coniform to apex.

Ornamentation.—*Sutural border,* wide, striate near apex; *lateral border,* narrower than sutural (in some specimens very clearly defined), has a deep groove on inside margin and is ornamented with very fine closely-set tubercles; *disc,* covered with about seventeen rows of pits, the diameter of the pits being 0·2 mm. and separated from one another by a distance somewhat greater than their diameter, pits in adjacent rows sometimes opposite, more frequently alternating. Pits on the *cast* (inside

surface) are sharply defined and annular, with a central core more or less irregular; on the *mould* (top surface) a large number of pits are present and, sometimes, faint impressions of the pits are exposed on the opposite side.

Convexity.—Moderately high.

Illustrations.—Fig. 39 (Specimen 61*a* × 8) shows the cylindraceous form of the elytron, also the parallel and sinuous rows of pits on the under surface (the cast); Fig. 39*a* (part of Specimen 61*a* × 12) is a section of the under surface showing the pits and cores, the latter being made up of fasciculate punctæ; Fig. 39*b* (part of Spec. 61*b* × 15) illustrates the upper surface of the elytron and shows the punctæ uniformly distributed, and not fasciculate as on the lower surface. Evidently the punctæ exposed on the top surface converge in bunches through to the lower surface and there form the pits.

Observations.—The specimen herein figured and the genotype of Etheridge and Olliff* vary in their border details, but not sufficiently for varietal distinction. The lateral border of the present figured specimen is not clearly defined and may be hidden by the matrix, but in the genotype it is quite pronounced.

The drawings by Etheridge and Olliff in their Memoir, as stated by Tillyard, "have been reversed in reproduction, and Fig. 1 (the mould) should have shown the external sculpture represented in Fig. 3, while Fig. 2 (the convex counterpart or cast) should have shown the internal impression."

Further examinations of the genotype indicate that even Fig. 3 is not quite correct, as the large circular impressions thereon shown might be particles of matrix dragged away from bunches of punctæ on the under surface and therefore would not be a true representation of the top surface sculpture. Certainly, on the top surface in the present figured specimen no impressions of pits are to be observed.

Compared with *Lobites* this genus has some resemblance in shape, but variations exist in ornamentation and in border details, and there is an absence of the incision on the disc.

Type.—Specs. S5*a*, S5*b* (Simmonds Collection). Paratypes.—Specs. 61*a*, 61*b* (cast and mould). Fig. 39, plate 5. G.S.Q. Coll.

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* Mesozoic and Tertiary Insects of N.S.W. (and Q'land). Mem. Geol. Surv. N.S.W., Palæontology No. 7. Sydney, 1890. Plate 2, Figs. 1-3.

Fam. CERAMBYCIDÆ.

Genus MESOTHORIS (Tillyard).

Genotype, *Mesothoris clathrata* (Tillyard).

Since the original specimen, the genotype, was discovered several years ago, a number of individuals have been unearthed, enabling a somewhat better conception being formed of the character of this much discussed genus. In the original description Tillyard states that "it resembles the recent Australian genus *Thoris* in the shape and sculpture of the elytra, which are marked all over with definite *alveolæ* separated by longitudinal and transverse ridges," and lately it has been suggested that *Mesothoris clathrata* should now be included in the recent genus *Omma*, one of the Cupedidæ, in view of the close resemblance of the two elytra to one another. An examination of a specimen of *Omma Stanleyi* in the possession of Mr. Froggatt, Entomologist, Department of Agriculture, Sydney, indicates that a decided likeness exists in regard to the form of the elytron, and also in the appearance of the individual alveolæ ornamenting it, but there the resemblance ceases.

The elytron of *O. Stanleyi* is made up of five well-marked longitudinal divisions, each separated from the other by a narrow but distinct ridge, each division being subdivided by a somewhat depressed zig-zag line, making in all ten subdivisions, with a row of alveolæ filling each subdivision. In *Mesothoris clathrata* the ridges are not present, and the number of alveolæ in one row is only about half that in a row on the disc of *O. Stanleyi*, although the number of rows is about the same. The main difference, however, is in the design of the ten longitudinal subdivisions in *O. Stanleyi*, of which the two adjacent to the lateral margin form a concentric band or border around the posterior margin to the apex, into which all the other eight subdivisions, which are all parallel to one another and to the straight sutural margin, join without any convergence. In *M. clathrata* no such wide border or marginal band is present.

Another recently discovered species, *M. grandis*, somewhat like *M. clathrata*, has the thorax and abdomen attached. These portions of the body do not resemble similar parts in *O. Stanleyi*, neither do they resemble those of the recent *Thoris*, so that the fossil form appears to have no affinity for either genus. Nevertheless, it is not desirable to alter the generic name for the present as more material has to be split and examined, and fresh discoveries are anticipated.

The genus now includes four species, all having somewhat elongated pod-shaped elytra, with sutural borders very narrow, a humeral area angulated and prominent, and a more or less alveolate disc. *M. grandis* has large elongated alveolæ, *M. clathrata* and *M. quadripartita* has smaller and somewhat oval or round alveolæ, while *M. tenui-clathrata* has very small, irregular and indistinct alveolæ.

In comparison with other genera, the alveolate structure is similar to that on the elytra of *Simmondsia*, but the differences between the two genera are in form, size, alveolæ and scutellary border details. In its elongated shape it somewhat resembles *Lobites*, but that genus has no alveolate elytra, and the ornamentation otherwise is dissimilar.

MESOTHORIS CLATHRATA (Tillyard).

Fig. 51, plate 6.

Mesothoris clathrata, Tillyard. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

ELYTRON.—

Size.—*Length*, 8 (restored ? 10) mm.; *width*, 2·5 mm.

Outline.—*Apex*, obtusely blunt; *base*, evidently short; *sutural margin*, gently arcuate; *lateral margin*, moderately arcuate; *general outline*, elongate-ovate, from middle of disc gently tapered both towards base and the rounded apex.

Ornamentation.—*Sutural and lateral borders*, moderately narrow; *disc*, has nine wide longitudinal ridges, with equally wide intersecting cross-ridges, the spaces between the crossed ridges forming oval or square alveolæ depressions or pits, and having a diameter equal in width to that of the ridges, the latter containing from three to five punctæ, which in the type specimens, however, are mostly obscured.

Illustrations.—Fig. 51, plate 6 (Spec. 48*b* × 10) shows the general arrangement of the alveolæ, and Fig. 51*a* (part of Spec. 48*b* × 30) illustrates the alveolæ and ridges, and the obscured punctæ.

Observations.—*M. clathrata* is between *M. quadripartita* and *M. grandis* in the size of the elytron and also in the size of the individual alveolæ. It differs from *M. tenuiclathrata* in having much larger lattice-like structure and the longitudinal and cross ridges much less numerous.

Type.—Spec. 48*b* (cast); Fig. 51, plate 6. (G.S.Q. Coll.) Type-counterpart.—Spec. 48*a* (mould). B. D. Coll. Ex Paratype.—Spec. 51*a-b* (now *M. quadripartita* paratype).

MESOTHORIS QUADRIPARTITA, *sp. nov.*

Fig. 50, plate 6.

ELYTRON.—

Size.—*Length,* 8 mm.; *width,* 2·3 mm.

Outline.—*Apex,* acutely rounded; *base,* wide, curvate; *scutellary margin,* sub-angulated with base and *sutural margin,* the latter strongly arcuate to apex; *humeral margin,* round, confluent with base and *lateral margin,* the latter slightly incurvate to apex; *general outline,* sub-lobiform.

Ornamentation.—*Sutural border,* very narrow, well-defined; *lateral border,* narrow near base, rapidly widening near humeral-lateral margin, gradually narrowing towards apex; *disc,* covered with a lattice-like structure made up of about fifteen rows of round, oval, and oblong pits or depressions, the sides of the pits being formed by the more or less defined longitudinal ridges and cross ridges, the disc being divided into four somewhat unequal sections separated from one another by lines of slight elevation. The first line is parallel to the arcuated sutural border, and extends from about the middle of base to the apex; the second line begins at humerus, is strongly curvate to the middle of disc, and then converges towards apex; the third line is close to the second at humerus, diverges to the middle of the disc, then converges towards apex; all lines being evanescent on apical quarter.

Convexity.—Moderately high generally, but declivous on lateral margin close to humeral area.

Illustrations.—Fig. 50 (Spec. 349*a* × 12) shows the four longitudinal sections into which the elytron is divided, and the elevated lines which separate them. Fig. 50*a* (part of Spec. 349*b* × 40) illustrates the clathrate or lattice-like structure of the surface, and also a small circular elevation or core in the centre of many of the depressions.

Observations.—*M. quadripartita* has many characters in common with *M. clathrata,* but the smaller size and greater number of the alveolæ and the division of the disc into four sections longitudinally are distinguishing characters.

Type.—Spec. 349*a* (cast); Fig. 50, plate 6. Paratype.—Spec. 51*a-b.* (G.S.Q. Coll.) Type-counterpart.—Spec. 349*b* (mould). B. D. Coll.

MESOTHORIS TENUICLATHRATA, *sp nov.*

Fig. 49, plate 6.

ELYTRON.—

Size.—*Length,* 6·8 mm.; *width,* 2·3 mm.

Outline.—*Apex,* acute, probably round; *base,* round, moderately long; *sutural* and *scutellary margins,* together strongly arcuate from base to apex; *lateral margin,* moderately arcuate from apex to *humeral margin,* the latter slightly porrect and confluent with the base; *general outline,* elongate-ovate.

Ornamentation.—*Sutural border,* hardly perceptible, but very narrow; *lateral border,* wide near middle, narrowing towards apex, evanescent on humerus, distinctly grooved on inside margin; *disc,* covered with about 15 ill-defined longitudinal rows of obscure depressions or pits, the elevations between adjacent pits producing a sub-clathrate appearance.

Convexity.—Uniformly and moderately high, except at humeral angle, where a protuberance on the disc produces a declivity near the adjacent border.

Illustrations.—Fig. 49 (Spec. 313*a* × 12) shows the general appearance of the elytron, and also the arcuate or bow-shaped lateral border. Fig. 49*a* (part of Spec. 313*a* × 40) illustrates the small clathræ formed by the longitudinal bars and the subordinate cross-pieces.

Observations.—This species with the *small lattice-like* structure resembles *M. clathrata* in many ways, but the sculpture is less pronounced, the size is smaller, the apex is differently shaped, and the clathrate depressions are very diminutive.

Type.—Spec. 313*a* (cast); Fig. 49, plate 6. (G.S.Q. Coll.)
Type-counterpart.—Spec. 313*b* (mould). B. D. Coll.

MESOTHORIS GRANDIS, *sp. nov.*

Fig. 48, plate 6.

THORAX.—

Metathorax.—Impression imperfect, but sufficient to indicate the depth to be somewhat less than the width, the posterior margin to be arcuate, and the ornamentation finely granulate.

ABDOMEN.—

Segments.—Made up of five pieces: 1st, somewhat arcuate, slightly longer on sides and centre, width being about six times the length; 2nd, somewhat shorter and straighter than 1st, longer on sides than centre; 3rd, straight, same length as 2nd, sides

and centre of equal length; 4th, somewhat similar to 3rd; pygidium equal in length to the combined length of 2nd, 3rd, and 4th segments; apex elliptical; the whole forming a dome whose length is about one and a-half times the diameter and which has a slight lateral constriction on the suture between 1st and 2nd segments; all segments coarsely granulate, some faintly ridged parallel to sutures; pygidium moderately and uniformly convex.

ELYTRON.—

SIZE.—*Length,* 13 (?) *mm.; width,* 3·1 mm.

OUTLINE.—*Apex,* unknown; *base,* unknown; *sutural margin,* incomplete; *lateral margin,* apical and basal portions missing, from middle to posterior margin strongly arcuate, from middle to anterior margin strongly incurvate; *general outline,* apparently lobiform.

ORNAMENTATION.—*Sutural-scutellary border* (incomplete), confluent, somewhat narrow, well-defined; *lateral border,* same width as sutural, well-defined; *disc,* covered with about ten narrow longitudinal costæ, with subordinate cross-bars somewhat wider than costæ, the shape of the alveolæ between the ridges varying between oval and oblong. On the scutellary area one of the costæ is short, and on the lateral side a few become evanescent, but ornamentation is generally distinct, the alveolate structure being deep, well-marked and regular.

CONVEXITY.—Somewhat high generally, declivous near lateral-humeral border.

ILLUSTRATIONS.—Fig. 48 (Spec. 54*a* × 8) shows the ornamentation of elytron and body, and also some elytral impressions on the metanotum. Fig. 48*a* (part of Spec. 54*a* × 20) is a section of the surface of one of the segments, and Fig. 48*b* (part of Spec. 54*a* × 25) shows the alveolate character of the disc.

OBSERVATIONS.—In comparison with *M. clathrata,* this species is a much longer and larger form, although somewhat similar in shape. It has also elongated and larger alveolæ, while the longitudinal costæ on the disc is relatively narrow.

TYPE.—Spec. 54*a* (cast); Fig. 48, plate 6. (G.S.Q. Coll.)-TYPE-COUNTERPART (Frag.).—Spec. 54*b* (mould), B. D. Coll.

Genus WILLCOXIA, gen. nov.

Genotype *Willcoxia magnopunctata,* sp. nov.

Only one specimen of this genus, *W. magnopunctata,* has been found. The sculpture of the elytra is very distinct, the

design in no way resembling that of any other of the Ipswich beetles, the lateral border being quite pronounced and wide, and the disc surface ornamented with shallow circular pits varying much in size and arranged in both parallel and obliquely connecting rows.

The genus has some resemblance to *Tillyardiopsis* in the elytron being pitted, but the arrangement of the punctæ is different and the shape is not the same. The elytron is somewhat like that of *Mesothoris* in outline, particularly in the shape of the apical and posterior lateral margins, and also in the extreme narrowness of the sutural borders, but otherwise there is no likeness.

The genus is named in honour of Mr. W. T. Willcox, who assisted in opening up the quarry many years ago and who found many of the type specimens.

WILLCOXIA MAGNOPUNCTATA, *gen. et sp. nov.*

Fig. 47, plate 6.

ELYTRON.—

Size.—*Length,* 10 mm. (?); *width,* 3·4 mm.

Outline.—*Apex,* acute; *base,* long, curvate; *scutellary margin,* round, confluent with base and *sutural margin,* the latter moderately arcuate with apex; *humeral margin,* sub-angulated with base and *lateral* (?) *margin,* the latter moderately arcuate to posterior margin, then slightly incurvate to apex; *general outline,* basal half sub-cylindraceous, apical half sub-coniform.

Ornamentation.—*Sutural border,* hardly perceptible, evidently very narrow; *lateral border,* rather wide, sides parallel with slight convergence on the incurved margin near apex; *disc,* ornamented with three longitudinal and two oblique double rows of large distantly-spaced pits, one extending from scutellary-basal margin towards apex, and approximately parallel to sutural margin, a second one extending from the base along the centre of disc towards the apex, a third row, made up of indistinct pits on one side of a deep stria, extending from humeral area towards apex, all three lines converging apically from about the middle, and all more or less evanescent on apical quarter. Another short double row of pits branches from the central row in the basal quarter and joins the sutural row about the middle of disc, a second similarly oblique and short row branching from central row about the middle, and

connecting with the sutural line on posterior area; other large and small pits are indiscriminately scattered over the surface but all, whether in rows or not, become evanescent near lateral border and towards apex.

Convexity.—Moderately high, somewhat uniform.

Illustrations.—Fig. 47 (Spec. 261*a* × 10) shows the details of the complex design of the disc ornamentation. Fig. 47*a* (part of Spec. 261*a* × 25) is a section of the disc showing the coalescence of the central oblique rows of pits with the longitudinal row near sutural border.

Observations.—No other species resembles this one in shape or in th *large-pitted* design of the ornamentation, although species of *Mesothoris* and *Mesostigmodera* may be compared to it in the character of the pits.

Type.—Specimen 261*a* (cast); Fig. 47, plate 6. (G.S.Q. Coll.) Type-counterpart.—Spec. 261*b* (mould). B. D. Coll.

Fam. **CURCULIONIDÆ** (?).

Genus TILLYARDIOPSIS, gen. nov.

Genotype *Tillyardiopsis tuberculata,* sp. nov.

All the species of this genus are conspicuous in having somewhat naviculate elytra, comparatively narrow sutural borders, and very wide lateral and humeral borders. The surfaces of the elytra are observed to be either granulate or tuberculate, and all have either a short deep longitudinal incision or a short line of close deep punctæ on the middle of the lateral half of the disc.

The genus is comparable with *Etheridgea* in ornamentation, but all the species have much larger elytra than that genus and their border details are different. *Tillyardiopsis* in some respects is comparable with *Elaterites,* but the outline, and size and border details are distinguishing features. The genus is separable from *Ademosyne* and *Platycrossos* in the elytra not being costate or striate, and from *Reeveana* in the variation in size, border details, and ornamentation.

The genus is named in honour of Dr. Tillyard, whose enthusiasm has been a great stimulating influence in the palæontological investigations on the fossil insect occurrences at Denmark Hill.

TILLYARDIOPSIS TUBERCULATA, *gen. et sp. nov.*

Fig. 57, plate 7.

ELYTRON.—

Size.—*Length,* 7 mm.; *width,* 2·7 mm.

Outline.—*Apex,* unknown; *base,* long, curvate; *scutellary margin,* round, confluent with base and sutural margin; *humeral margin,* round, confluent with base and lateral margin; *sutural margin,* moderately arcuate from scutellum; *lateral margin,* moderately curvate from humerus; *general outline,* naviculate.

Ornamentation.—*Basal border,* somewhat narrow near scutellary border, into which it merges; much enlarged on humeral side, so much so that the inside edge extends from the scutellary-basal junction directly and obliquely to a position on the lateral border about one-fifth the length of the elytron from the base, and forming a large basal-humeral triangular area; *lateral border,* very wide, edges very slightly converging towards apex; *sutural border,* same width as scutellary border in its narrowest part, and somewhat narrower than lateral border, a thick line forming its outside edge from base to posterior margin, with a tuberculated line forming its inside edge; *disc,* ornamented with at least eleven equidistant rows of variously sized tubercles, each of which converge from the basal quarter to apex, and with each tubercle approximately equidistant from one another, that is about equal to the distance between each line. On the lateral portion of the disc, close to the middle, a short line of acuminated elevations are present, the counterparts of which on the "cast" specimen show as deep pits; surface sculpture becomes evanescent towards the base on the lateral side, and also on the apical quarter.

Convexity.—Borders all explanate, disc uniformly and moderately high.

Illustrations.—Fig. 57 (Spec. 133*a* × 12) shows the character of the borders, the arrangement of the tubercles and the short line of pimples on the lateral half of the disc. Fig. 57*a* (part of Spec. 133*a* × 25) shows the somewhat irregular size of the tubercles and their arrangement.

Type.—Spec. 133*a* (mould); Fig. 57, plate 7. (G.S.Q. Coll.).
Type-counterpart.—Spec. 133*b* (cast). B. D. Coll.

Observations.—The size and shape of the elytron are comparable with those of the other two species of this genus, but the ornamentation is quite different in being regularly tuberculate, its border details being quite distinct.

TILLYARDIOPSIS GRANULATA, *sp. nov.*

Fig. 56, plate 7.

ELYTRON.—

Size.—*Length,* 6·8 mm.; *width,* 2·6 mm.

Outline.—*Apex,* obtusely pointed; *base,* long, nearly straight; *scutellary margin,* sub-angulated with base and *sutural margin,* the latter moderately arcuate to apex; *humeral margin,* sub-angulated with base and *lateral margin,* the latter nearly straight from base to middle, then strongly arcuate to apex; *general outline,* naviculate.

Ornamentation.—*Basal border,* wide, merging into wide *scutellary border,* this becoming narrow and merging into narrow *sutural border,* the latter being very narrow at apex; *humeral border,* wider than basal, becoming slightly narrower as it merges into *lateral border,* the latter very gradually diminishing in width to the apex, where it joins the narrow sutural border; *all borders,* well-defined; *disc,* generally granulate, rugulose near apex; well-defined incision on the middle of lateral half; three broken closely-parallel lines obliquely crossing from humerus to about the centre of disc.

Convexity.—All borders explanate, disc uniformly and moderately high.

Illustrations.—Fig. 56 (Spec. 289*a* × 12) shows the general shape, wide borders, and incision on the disc. The three broken lines on the disc might be impressions accidently produced by a plant fragment. Fig. 56*a* (part of Spec. 289*a* × 50) is a section across the apical portion where the surface is both granulate and rugulose.

Observations.—In outline this *granulated* species may be compared with some of the forms of *Ademosyne,* differing, however, in size, ornamentation and borders. *Reevcana minor* somewhat resembles it in shape and borders, but size, ornamentation and the presence of the incision of the disc are distinguishing features. *Lobites granulatus* has features in common with it, but varies in size and border arrangements. The species is separated from *T. tuberculata* and *T. variotubercula* by the marked differences in its disc sculpture.

Type.—Spec. 289*a* (cast); Fig. 56, plate 7. (G.S.Q. Coll.)
Type-counterpart.—Spec. 289*b* (mould). B. D. Coll.

TILLYARDIOPSIS VARIOTUBERCULA, *sp. nov.*

Fig. 58, plate 7.

ELYTRON.—

Size.—*Length,* 6·5 mm.; *width,* 2·5 mm.

Outline.—*Apex,* unknown; *base,* long, irregularly curvate; *scutellary margin,* round, confluent with base and *sutural margin,* the latter moderately curvate towards apex; *humeral margin,* round, confluent with base and sub-angulated with *lateral margin,* the latter wide and parallel-sided on posterior margin, not distinguishable on other portions; *general outline,* naviculate.

Ornamentation.—*Basal border,* wide, irregular, merging into indefinite *scutellary* and *humeral borders; sutural border,* very narrow on anterior margin, gradually widening towards posterior margin, where it is wide and striate, and equal in width to posterior *lateral border; disc,* covered by lines or rows of tubercles arranged somewhat irregularly between the base and the middle of disc, where the number of rows is about 16, but converging and anastamosing towards the apex, where the number is about 9, the tubercles varying much in size and distance from one another. A short deeply punctate stria is present near the middle of the lateral half of the disc.

Convexity.—The sutural border near apex is rounded, while the preserved portion of the lateral border is explanate; surface of disc moderately and uniformly high and quite distinct from borders.

Illustrations.—Fig. 58 (Spec. 66*a* × 12) shows the general arrangement of the tubercles, and Fig. 58*a* (part of Spec. 66*a* × 25) is a portion of the disc surface illustrating the arrangement and variation in the size of the tubercles.

Observations.—The species has several features in common with *T. tuberculata,* particularly in shape and size, but the design of tubercle ornamentation is quite different, besides which there is a wide *variation in the size of the tubercles,* its specific character.

Type.—Spec. 66*a* (cast); Fig. 58, plate 7. (G.S.Q. Coll.)
Type-counterpart.—Spec. 66*b* (mould). B. D. Coll.

Genus ETHERIDGEA.

Genotype, *Etheridgea australis,* Handlirsch.

ETHERIDGEA AUSTRALIS, *Handlirsch.*

Fig. 60, plate 7.

Etheridgea australis, Tillyard. Mesozoic and Tertiary Insects of Queensland, &c. Queensland Geol. Surv. Pub. No. 253. Brisbane, 1916.

Etheridgea australis, Handlirsch. Die Fossilen Insekten. Leipzig, 1908.

Glochinorrhynchus (*?*), Etheridge and Olliff. Mem. Geol. Surv. N.S.W. Palæontology, No. 7. Sydney, 1890.

ELYTRON.—

Size.—*Length,* 3·6 mm.; *width,* 1·4 mm.

Outline.—*Apex,* obtusely pointed (*?*); *base,* unknown; *sutural margin,* nearly straight; *lateral margin,* curvate; *general outline,* not defined on account of distortion, but probably cuneate or elongate-piriform.

Ornamentation.—*Sutural border,* narrow, defined; *lateral border,* narrow and defined where exposed; *disc,* covered with tubercles varying in size, prominence, and in their distance from one another, and arranged in thirteen rows.

Convexity.—Probably high.

Illustrations.—Fig. 60 (Spec. S4 × 20) shows the crumpled elytron, the longitudinal lines of which represent distortion marks. Fig. 60*a* (part of Spec. S4 × 40) is a section showing the irregularity in the size of the tubercles.

Observations.—The original drawing by Etheridge and Olliff is incorrectly shown to be the left elytron, the type specimen being the right elytron. No other specimen approaches this form in appearance, the nearest being *Tillyardiopsis tuberculata,* which, however, has a different design in the tubercular ornamentation, and is much larger.

Type.—Spec. S4 (cast); Simmond's collection. (Fig. 60, plate 7.)

Fam. **DASCILLIDÆ** (*?*).

Genus LEIOODES, *gen. nov.*

Genotype, *Leioodes planum,* sp. nov.

The two species in this genus are very small individuals, the elytron of one, *L. pygmæum,* being only 1·2 mm. in length and, therefore, the smallest fossil so far discovered in the Ipswich quarry. In both species the disc of the elytron is somewhat high, and with very little ornamentation—only faint lines being

observable—and in shape both are very regularly arcuate on the lateral margins. *L. planum* has the prothorax preserved and, like the elytra, is only faintly ornamented. The genus is comparable with *Apheloodes,* from which it varies in the shape of both elytra and prothorax, and in the character of the disc ornamentation.

That the fossils actually belong to the Coleoptera is open to doubt, and some forms in the Heteroptera, particularly the Pentatomidæ, much resemble the genus in its appearance. [Ety.: *leios,* smooth; *oodes,* oval.]

LEIOODES PYGMÆUM, *gen. et. sp. nov.*

Fig. 52, plate 6.

ELYTRON.—

Size.—Length, 1·2 mm.; *width,* 0·4 mm.

Outline.—*Apex,* acutely pointed; *base,* equal in length to the full width of elytron; *scutellary margin,* round, very small; *humeral margin,* angulated, very small; *sutural margin,* straight from apex to base; *lateral margin,* uniformly and moderately arcuate from apex to base; *general outline,* subcuneate.

Ornamentation.—Borders on margins very narrow or absent; disc irregularly and faintly ornamented with a few short striolæ, otherwise lævigate.

Convexity.—High generally, near apex and posterior margin very high.

Illustrations.—Fig. 52 (Spec. 287*a* × 30) shows the inornate appearance of the elytra, and Fig. 52*a* (part of Spec. 287*a* × 50) is a section of the disc illustrating the faint evanescent striolæ.

Observations.—This *little* species is comparable with *L. planum,* under which some notes are given on differences and resemblances.

Type.—Spec. 287*a* (cast); Fig. 52, plate 6. (G.S.Q. Coll.)
Type-counterpart.—Spec. 287*b* (mould). B. D. Coll.

LEIOODES PLANUM, *sp. nov.*

Fig. 53, plate 6.

PRONOTUM.—

Outline.—*Anterior margin,* slightly curvate, half the length of posterior margin, the distance between the two margins being about equal to the length of the anterior margin; *posterior*

margin, slightly curvate opposite each elytron; *lateral margin,* curving and converging from posterior angle to anterior margin with which it is obtusely angulated; *general outline,* truncate-coniform.

Ornamentation.—Two faint sutural lines cross centre and suggest the disc having equal basal, middle and anterior divisions; disc faintly granulate, and faint vittate impressions suggest its being in four oblique divisions somewhat parallel to lateral border and converging to central line.

ELYTRON.—

Size.—*Length,* 1·8 mm.; *width,* 0·6.

Outline.—*Apex,* acutely round; *base,* wide, slightly curvate; *sutural margin,* straight; *lateral margin,* moderately arcuate; *humeral* and *scutellary angles,* each nearly rectangular; *general outline,* sub-cuneate.

Ornamentation.—*Sutural border,* evidently very narrow; *lateral border,* narrow, somewhat irregular, extending to apex; *disc,* smooth, with impressions of three faint, granulate, equidistant vittæ, evidently concentric with lateral border and coinciding with similar vittæ on pronotum.

Convexity.—Elytra generally low on sutural portions and moderately high on lateral and apical areas, the disc of the pronotum being explanate centrally and high laterally in conformity with the elytra, the pronotum and elytra together forming a moderately high, smooth, egg-shaped body.

Illustrations.—Fig. 53 (Spec. 348*a* × 30) shows the generally *plain* dorsal surface of the individual with its narrow lateral borders and its almost imperceptible vittate markings.

Observations.—This species resembles *L. pygmæum* in some of its elytral characters, but is larger, longer in proportion, and different in its sculptural details. Comparable with *Apheloodes rugosum* and *A. obliquum* in size and somewhat in shape, but quite distinct in all other respects.

Type.—Spec. 348*a* (cast); Fig. 53, plate 6. (G.S.Q. Coll.). Type-counterpart.—Spec. 348*b* (mould). B. D. Coll.

Genus APHELOODES, *gen. nov.*

Genotype *Apheloodes obliquum* sp. nov.

The species of this minute genus commonly occur at Ipswich, but the elytra are invariably found attached to the thorax.

Probably the connecting integument is less perishable than in most of the other beetles, but if detached elytra were also to be seen it would add to the assurance that these small forms, like *Leioodes,* do not belong to the Heteroptera. [Ety.: *apheles,* simple; *oodes,* oval.]

APHELOODES RUGOSUM, *gen. et sp. nov.*

Fig. 55, plate 6.

PRONOTUM.—

Outline.—Somewhat obscure, but apparently lunate, the convex portion forming the anterior lateral margin, and the concave portion the posterior margin.

Ornamentation.—Profusely rugose along very irregular short lines approximately parallel to the margins, with rugulose-granulate sculpturing between rugæ.

ELYTRON.—

Size.—*Length,* 1·8 mm.; *width,* 0·6 mm.

Outline.—*Base,* somewhat obscure, apparently curvate; *sutural margin,* straight; *lateral margin,* moderately arcuate; *scutellary margin,* obscure; *humeral margin,* apparently round and confluent with both base and lateral margin; *general outline,* cordate-ovate (of the two elytra), the *apex* being broadly round.

Ornamentation.—*All borders,* obscure; *disc,* in centre of areas smooth, but towards lateral, basal and apical portions, rugæ are present and somewhat parallel to margins, with rugulose structure between rugæ in the same areas. The suture between elytra very marked on basal third, faint or evanescent about middle, short and well-marked on apical quarter, and apparently absent on apical point.

Convexity.—Moderately low.

Illustration.—Fig. 55 (Spec. 236*a* × 30) shows the simple egg-shaped form of the body as a whole; also the rugæ and rugulæ on the surface of the elytra and pronotum.

Observations.—The form of this species, as in the case of *A. obliquum,* is somewhat obscure, and its state of preservation is far from being good. Although quite a number of specimens have been examined, all have the same *wrinkled* and the partly-destroyed surface ornamentation, which suggests the presence of an exceedingly delicate and fragile tegument. It differs from *A. obliquum* in not having oblique straight lines

on the elytra, and from *Leioodes planum* in outline and in the absence of a definite lateral border, also in many details of surface ornamentation.

TYPE.—Spec. 236*a* (cast); Fig. 55, plate 6. (G.S.Q. Coll.).
TYPE-COUNTERPART.—Spec. 236*b* (mould). B. D. Coll.

APHELOODES OBLIQUUM, *sp. nov.*

Fig. 54, plate 6.

PRONOTUM.—

OUTLINE.—Somewhat obscure, apparently truncate-coniform, with a lateral-posterior extension conforming with a round humeral margin.

ORNAMENTATION.—Striate irregularly, the lines curving and converging anteriorly from lateral margins to centre of disc, with interlineal rugulæ.

ELYTRON.—

SIZE.—*Length,* 2·0 mm.; *width,* 0·6 mm.

OUTLINE.—*Base,* short, straight; *humeral margin,* large, curvate, conformable with base and lateral margin, the latter moderately arcuate to apex; *scutellary margin,* absent (?); *sutural margin* straight from base to apex; *general outline,* elongate-cordate (*i.e.,* of the two elytra together) with a narrow round apex.

ORNAMENTATION.—*Lateral border,* very narrow; *other borders,* not observed; *disc,* ornamented with two oblique striæ, one starting from humeral-basal margin and joining sutural margin at basal quarter, the other beginning at the humeral-lateral margin and joining sutural margin at apical quarter, striæ being distinct but very narrow and shallow; other portion of surface irregularly rugose, and apparently a *post-mortem* effect.

CONVEXITY.—Moderately low.

ILLUSTRATION.—Fig. 54 (Spec. 143*a* × 30) shows the rugose character of the pronotum, the oblique striæ and the general fusiform-ovate shape of the body as a whole.

OBSERVATIONS.—This *obliquely* striated species like *A. rugosum,* is an obscure form and the remarks under the heading of that species would also apply in this case.

TYPE.—Spec. 143*a* (cast); Fig. 54, plate 6. (G.S.Q. Coll.).
TYPE-COUNTERPART.—Spec. 143*b* (mould). B. D. Coll.

Summary Table (Ipswich Fossil Coleoptera).

ELYTRAL CHARACTERS.

Name.	Publication No. 273.			Size.		Shape.				Ornamentation.			Borders.	
Genera and Species.	Figure.	Plate.	Type No.	Length m.m.	Width m.m.	General Outline.	Base.	Apex.	Convexity.	Costæ.	Striæ.	General Surface.	Sutural.	Lateral.
ELYTRON—PUNCTATE-STRIATE, WITHOUT WIDE BORDERS, 8 TO 10 COSTÆ.														
			S. 1.											
Ademosyne Olliffi	9	1	35	1·8	0·7	Long-ovate	Curvate	Obtuse	Rather low	8, round	Faint-punctate	Crenulate	V. narrow	V. narrow
„ parva	8	1	312	2·0	0·8	Nav.-ovate	Nr. straight	Acute	Rather high	8 or 9	Punctate	Granulate	Narrow	Narrow
„ intermedia	2	1	233	2·2	1·1	Wide-ovate	Curvate	Obtuse	High	8 sub-carinate	Deep-punctate	Granulate	Narrow	Narrow
„ lata	5	1	132	2·2	1·1	Ovate	Straight	?	Mod. high	9, nearly flat	Deep-fine-punctate	Smooth	Mod.-wide	Mod.-wide
			S. 2.											
„ major	1 & 12	1 & 2	36	2·6	1·0	Tapered	Curvate	Acute	Mod. high	8 or 9, round	Deep-fine-punctate	Granulate	Narrow	Narrow
„ brevis	6	1	339	2·6	1·4	Piri-ovate	Irregular	Obtuse	Mod. low	9, round	Punctate	Grano-cren.	Narrow	Wide
„ curvata	7	1	274	2·8	1·0	Oblong-ovate	Curvate	Obtuse	Mod. low	(?) 8, equally wide	Deep-punctate	Smooth	Narrow	Narrow
„ australiensis	3	1	12	3·4	1·2	Long-ovate	Straight	Blunt	Gen. high	10, depressed	Punctate	Smooth	Mod. narrow	Mod. narrow
„ ramo-costata	4	1	225	3·5	1·4	Tapered	Straight	Pointed	High	10, round	Fine-punctate	Smooth	Narrow	Mod. narrow
„ rugulosa	10	1	260	3·6-4·2	1·3-4	Long-ovate	Curvate	Pointed	Mod. high	9-11, flattish	Fine-punctate	Granulate	Mod. narrow	Mod. narrow
„ vittamargina	13	2	341	4·0	1·4	Long-ovate	Round	Pointed	V. low	10, flat	Punctate	Pustulate	Narrow	Narrow
„ congener	16	2	40	4-5	2·1	Ovate	Nr. straight	Round	Mod. high	9-10, round	Fine-punctate	Smooth	Mod. narrow	Mod. narrow
„ punctata	15	2	47	4-4·2	1-1·2	Subulate-ovate	Curvate	Round	Mod. high	9, flat	Shallow-punctate	Smooth	Narrow	Narrow
„ adunca	14	2	194	6·0	2·2	Nav.-ovate	Sinuate	Pointed	Mod. low	10, low	Fine-punctate	Granulate	Narrow	Narrow
„ Cameroni	11	2	46	6·2	3·0	Ovate	Curvate	Pointed	Rather high	9, round	Punctate	Smooth nr. base	Narrow	Narrow
ELYTRON—IMPUNCTATE-STRIATE, NAR. OR MOD. WIDE BORDERS, 9 TO 11 COSTÆ.														
			S. 3.											
Ademosynoides minor	18	2	38	2·0	0·1	Oblong-ovate	Round	Pointed	High	9, round	Impunctate	Smooth	Narrow	Narrow
„ striatella	26	2	16	2·2	1·1	Long-ovate	Curvate	Round	High	9-10, flattish	Impunctate	Granulate	V. narrow	V. narrow
„ obtusa	17	2	9	2·4	1·0	Long-ovate	Nr. straight	Pointed	High	9, round	Impunctate	Granulate	Narrow	Narrow
„ alternata	19	2	149	2·5	1·0	Long-ovate	Round	Round	High	8, alternating	Impunctate	F.-granulate	Mod. narrow	Mod. narrow
„ angusta	20	3	15	3·0	1·0	Nav.-ovate	Round	Pointed	Low	9-10, flattish	Impunctate	Granulate	Narrow	Narrow
„ attenuata	25	3	161	5·7	1·8	Double-taper	Curvate	Round	V. low	10, flat	Impunctate	Smooth	Narrow	Mod. narrow
„ abnormis	23	3	243	6·2	2·5	Long-ovate	Curvate	Pointed	Mod. high	9, round (in part)	Impunctate	Granulate	Narrow	Narrow
„ magnifica	27, 28	3	199	8·5	2·9	Long-ovate	Round	Pointed	Mod. high	(?) 10, flat	Impunctate	Granulate	Mod. wide	Narrow
ELYTRON—COSTATE, STRIATE, PUNCTATE, WIDE BORDERS.														
Platycrossos ligulatus	22	3	268	2·9	1·2	Ovate	Curvate	Pointed	High	8-9, faint	Punctate (?)	Smooth	V. narrow	V. wide
„ sub-tumidus	24	3	171	3·0	1·6	Cupolate	Straight	Round	Mod. high	10, round	Punctate	F. granulate	?	V. wide
„ tumidus	21	3	45	7·5	2·9	Ovate	Nr. straight	Round	V. high	9, round nr. base	Punctate (in part	Granulate	V. narrow	V. wide
ELYTRON—ALVEOLATE, LONGITUDINALLY RIDGED AND CROSS-BARRED.														
Simmondsia sub-piriformis	34	4	135	3·0	1·2	Nav.-ovate	Curvate	Round	Mod. low	8 costæ, narrow with cross-bars ; alveolate			Narrow	Mod. wide
„ cylindrica	29	4	87	5·0?	1·4	Cylindraceous	Straight	?	Low	8 costæ, narrow with cross-bars ; alveolate			V. narrow	V. narrow
ELYTRON—ELONGATE-GRANULATE.														
Grammositum bilineatus	35	4	136	2·5	0·8	Long-ovate	Straight	Round	Low	2 striæ, punctate, surface granulate			V. narrow	V. narrow
ELYTRON—DISC VITTATE.														
Shepherdia quadrivittata	32	4	130	110	3·4	Long-coniform	Curvate	Round	Low	4 longitudinal vittæ, surface rugulose			Narrow	Narrow
ELYTRON—UNIFORMLY GRANULATE.														
Polysitum minutus	59	7	336	2·2	1·2	Ovate-cordate	Curvate	Obtuse	Mod. high	Irregularly vittate, granulate			Indistinct	Indistinct
„ punctatus	36, 37	4	153	6·9	2·7	Ovate	Curvate	Round	Low	Surface uniformly punctate			Narrow	Narrow
ELYTRON—CYLINDRACEOUS, COSTATE, PUNCTATE-STRIATE, LARGE SIZE.														
Ulomites Willcoxi	33	4	50	11·0	3·0	Cylindraceous	Acute	Curvate	Low	8 costæ, 1 very large, punctate striæ			Narrow	V. narrow

SUMMARY TABLE (Ipswich Fossil Coleoptera)—*continued.*

Name.	Publication No. 273.			Size.		Shape.				Ornamentation.	Borders.	
Genera and Species.	Figure.	Plate.	Type No.	Length m.m.	Width m.m.	General Outline.	Base.	Apex.	Convexity.		Sutural.	Lateral.
ELYTRON—COSTATE, RUGULOSE, GRANULATE, ELONGATE, MOD.-NAR. BORDERS.												
Elaterites subulatus	31	4	263	4·3	2·0	Subulate	Acute ?	Round	High	Surface wavy	Mod. narrow	Mod. narrow
„ transversus	30	4	159	6·5	2·7	Sub-ovate	Acute	Curvate	High	5 very narrow costæ ; rugulose	Mod. nar. ?	Mod. nar. ?
ELYTRON—PUNCTATE-STRIATE, ELONGATE, COSTÆ PARALLEL.												
Elaterium bipunctatum	46	5	292	4·4	1·4	Naviculate	Acute	?	High	8 narrow costæ, doubly punctate striæ	Narrow	Mod. narrow
„ punctomarginum	43	5	200	7·0	2·2	Cylindraceous	Acute	?	Mod. high	9 pitted striæ, row of pits on lat. border	Narrow	Wide
ELYTRON—FAINTLY ORNAMENTED, TAPERED, MOD.-WIDE LAT. BORDERS.												
Reeveana major	38	5	251	5·4?	1·9	Sub-ovate	?	Round	Low	2 concentric vittæ, surface smooth	Narrow	Wide
„ intermedia	45	5	201	3·6	1·4	Cuneate	?	Curvate	Low	4 faint striæ, surface smooth	Mod. wide	Narrow
„ minor	42	5	297	3·0	1·0	Sub-ovate	Acute	Curvate	Round	Rugæ traces, surface smooth	Narrow	Wide
ELYTRON—ALTERNATE, STRIATE, COSTATE, NARROW BORDERS.												
Tryoniopsis punctata	65	7	250A	6·0	2·1	Attenuated	Acute	Round	Low	10 low costæ, striæ punctate	V. narrow	V. narrow
„ granulata	59	7	161A	5·7	1·8	Attenuated	Acute	Curved	Low	10 low costæ, striæ impunctate	Narrow	Narrow
ELYTRON—POD-SHAPED, BISINUATE LAT. MARGIN, ARCUATE SUT. MARGIN.												
Lobites tuberculatus	41	5	342	5·8	1·8	Fabiform	Obtuse	Curvate	Mod. high	4 tuberculated rows	Mod. narrow	Mod. narrow
„ granulatus	40	5	183	8·3	3·0	Fabiform	?	Curvate	Mod. high	3 tuberculated rows	? Narrow	Mod. wide
„ trivittatus	44	5	164	12·5	3·4	Cylindraceous	Acute	Curvate	Mod. low	3 vittæ, finely granulate surface	Wide	V. narrow
ELYTRON—ELONGATE-CYLINDRACEOUS, PITTED IN ROWS, LARGE SIZE.												
Mesostigmodera typica	39	5	S. 5. 61	15·0	4·8	Cylindraceous	Pointed	Curvate	Mod. high	17 pitted rows	Wide	Mod. narrow
ELYTRON—ELONGATE OR POD-SHAPED, ALVEOLATE OR CLATHRATE, V. NAR. SUT. BORDER, LARGE SIZE.												
Mesothoris tenuiclathrata	49	6	313	6·8	2·3	Long-ovate	Round ?	Round	Mod. high	(?) 14 obscure rows, sub-clathrate	V. narrow	Mod. wide
„ quadripartita	50	6	349	8·0	2·3	Sub-lobiform	Blunt	Curvate	Mod. high	4 longitudinal sections, alveolate	Narrow	Mod. wide
„ clathrata	51	6	48	(10·0)	2·5	Long-ovate	Blunt	?		9 costæ and cross-bars, alveolate	Mod. narrow	Mod. narrow
„ grandis	48	6	54	13 ?	3·1	Lobiform ?	?	?	Mod. high	10 narrow costæ and cross-bars, alveolate	Mod. narrow	Mod. narrow
ELYTRON—ELONGATE, PARALLEL AND OBLIQUE ROWS OF PITS, LARGE SIZE.												
Willcoxia magnopunctata	47	6	261	10 ?	3·4	Cylindraceous	Acute	Curvate	Mod. high	3 longitudinal, and 2 oblique rows of pits	V. narrow	Mod. wide
ELYTRON—BOAT-SHAPED, NAR. SUT. BORDER, VERY WIDE LAT. BORDER, TUBERCULATE OR GRANULATE, LARGE SIZE.												
Tillyardiopsis variotubercula	58	7	66	6·5	2·5	Naviculate	?	Curvate	Mod. high	9 to 16 rows of variable tubercles	Mod. wide	Wide ?
„ granulata	56	7	289	6·8	2·6	Naviculate	Blunt	Straight	Mod. high	Surface rugulose-granulate	Narrow	Mod. wide
„ tuberculata	57	7	133	7·0	2·7	Naviculate	?	Curvate	Mod. high	11 tuberculated rows	Wide	V. wide
ELYTRON—MANY ROWS OF TUBERCLES, SMALL SIZE.												
Etheridgea australis	60	7	34	3·6	1·4	Cuneate ?	Obtuse ?	?	High ?	13 rows of variable tubercles	Narrow	Narrow
ELYTRON—VERY FAINTLY ORNAMENTED WITH LINES OR VITTÆ, V. NAR. BORDERS, V. SMALL SIZE.												
Leloodes pygmaeum	52	6	287	1·2	0·4	Sub-cuneate	Acute	Straight	High	Surface faintly streaked	Narrow ?	Narrow ?
„ planum	53	6	348	1·8	0·6	Sub-cuneate	Blunt	Curvate	Mod. high	3 faint granulate vittæ	Narrow ?	Narrow
ELYTRON—RUGOSE LINES CONCENTRIC WITH LAT. BORDERS, SOMETIMES WITH TWO OBLIQUE LINES.												
Apheloodes rugosum	55	6	236	1·8	0·6	Semi-cordate	Blunt	?	Low	Surface rugose and rugulose	Narrow ?	Wide ?
„ obliquum	54	6	143	2·0	0·6	Semi-cordate	Blunt	Straight	Mod. low	2 oblique striæ, wide apart	V. narrow	V. narrow

PLATE 1.

Ademosyne major *Handlirsch* (mould)
(36a. L.2·6. W.I. × 30; Fig. 1a × 50).
(See page 15).

,, intermedia *sp. nov.* (cast)
(233b. L.2·2. W.1·1 × 30; Fig. 2a × 40).
(See page 14).

,, australiensis *Tillyard* (cast)
(12b. L.3·4. W.1·2 × 25; Fig. 3a × 50).
(See page 19).

,, ramocostata *sp. nov.* (cast)
(225. L.3·5. W.1·4 × 25; Fig. 4a × 40).
(See page 19)

,, lata *sp. nov.* (mould)
(132a. L.2·2. W.1·1 × 30; Fig. 5a × 50).
(See page 15).

,, brevis *sp. nov.* (cast)
(339a. L.2·6. W.1·4 × 30; Fig. 6a × 40).
(See page 17).

,, curvata *sp. nov.* (cast)
(274a. L.2·8. W.1. × 30; Fig. 7a × 50).
(See page 18).

,, parva *sp. nov.* (cast)
(312a. L.2. W.0·8 × 30; Fig. 8a × 50).
(See page 13).

,, Olliffi (*Handlirsch*) (cast)
(35. L.1·8. W.0·7 × 30; Fig. 9a × 50).
(See page 12).

,, rugulosa *sp. nov.* (cast)
(260a. L.4. W.1·4 × 20; Fig. 10a × 35).
(See page 20).

,, rugulosa *sp. nov.* (cast)
(299a in part, × 20).

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rtical marks indicating actual size on Plate 1 are 0·1 too large.

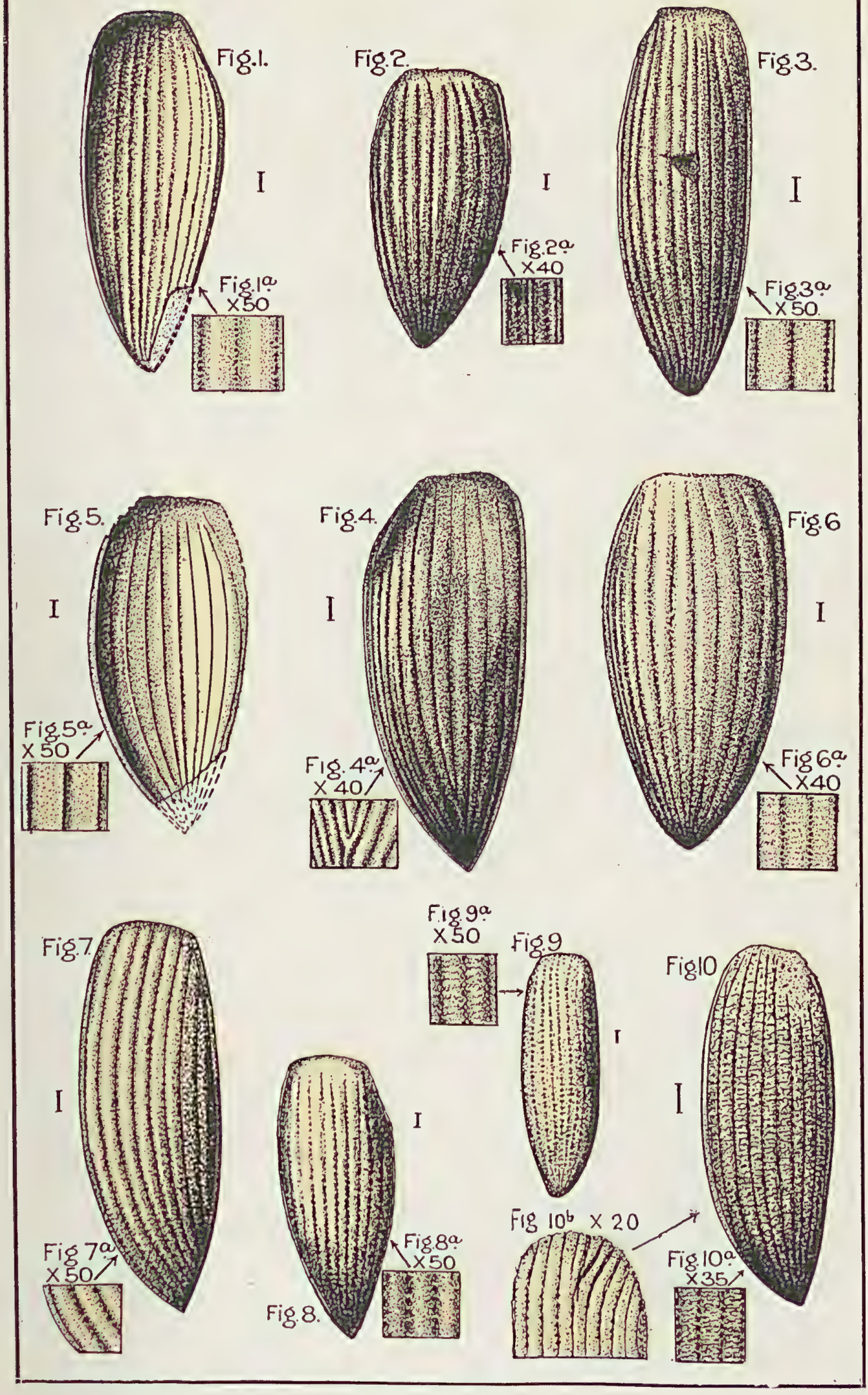
Fig.1.
I
Fig.1a
X50
Fig.2.
I
Fig.2a
X40
Fig.3.
I
Fig.3a
X50
Fig.5.
I
Fig.5a
X50
Fig.4.
I
Fig.4a
X40
Fig.6
I
Fig.6a
X40
Fig.7.
I
Fig.7a
X50
Fig.9a
X50
Fig.9
I
I
Fig.8a
X50
Fig.8.
Fig.10
I
Fig 10b X 20
Fig.10a
X35

PLATE 2.

Fig. 11. Ademosyne Cameroni *Tillyard* (cast)
(46b. L.6·2. W.3 × 15; Fig. 11a × 25).
(See page 24).

Fig. 12. „ major *Handlirsch* (cast)
(S2. L.4. W. 2·4 × 15).
(See page 15).

Fig. 13. „ vittamargina *sp. nov.* (cast)
(341a. L.4. W.1·4 × 20; Fig. 13a × 40).
(See page 21).

Fig. 14. „ adunca *sp. nov.* (cast)
(194b. L.6. W.2·2 × 12; Fig. 14a × 25).
(See page 23).

Fig. 15. „ punctata *Tillyard* (cast)
(47b. L.4. W.1·2 × 25; Fig. 15a × 50).
(See page 23).

Fig. 16. „ congener *Tillyard* (cast)
(40. L.4·2. W.2·1 × 18; Fig. 16a × 40).
(See page 22).

Fig. 17. Ademosynoides obtusa (*Tillyard*) (cast)
(9b. L.2·4. W.1 × 30; Fig. 17a × 50).
(See page 26).

Fig. 18. „ minor (*Handlirsch*) (cast)
(38b. L.2. W.0·8 × 30; Fig. 18a × 50).
(See page 26).

Fig. 19. „ alternata *sp. nov.* (cast)
(149a. L.2·5. W.1 × 30; Fig. 19a × 40).
(See page 27).

Note.—Vertical marks indicating actual size on Plate 2 are 0·1 too large.

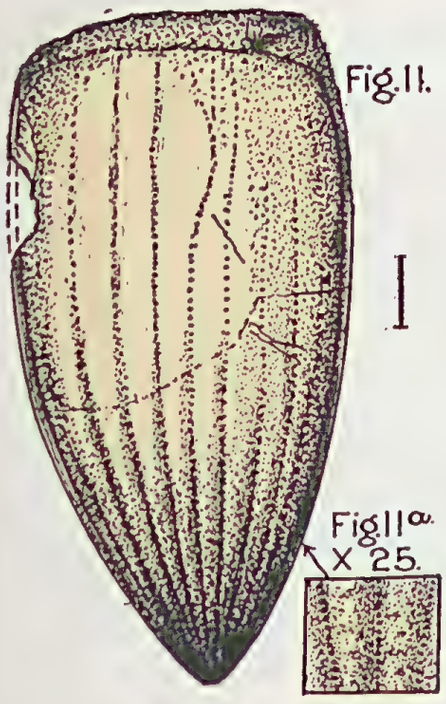
Fig.11.
Fig.11a
x 25.

Fig.12

Fig.13
Fig.13a
x 40

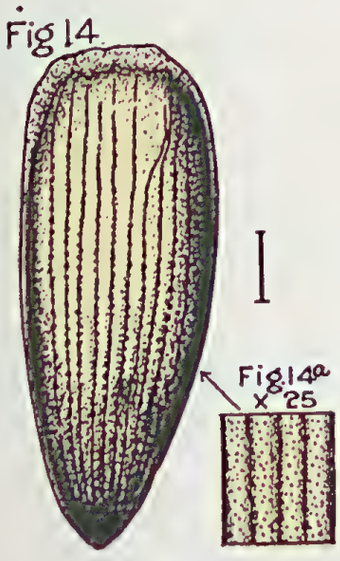
Fig.14
Fig.14a
x 25

Fig.15
Fig.15a
x 50

Fig.16
Fig.16a
x 40

Fig.17.
Fig.17a
x 50

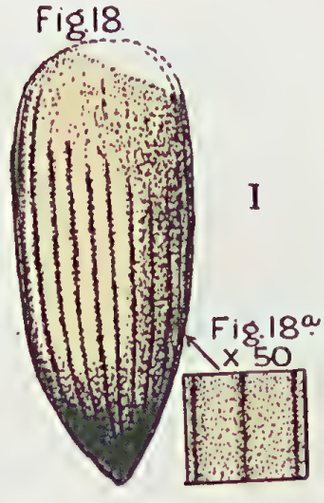
Fig.18
Fig.18a
x 50

Fig.19
Fig.19a
x 40

PLATE 3.

Fig. 20. Ademosynoides angusta (*Tillyard*) (cast)
(15b. L.3. W.1 × 25; Fig. 20a × 50).
(See page 29).

Fig. 21. Platycrossos tumidus (*Tillyard*) (cast)
(45b. L.6·2. W.2·5 × 12; Fig. 21a × 25).
(See page 34).

Fig. 22. ,, ligulatus *sp. nov.* (cast)
(268a. L.2·9. W.1·2 × 30; Fig. 22a × 45).
(See page 33).

Fig. 23. Ademosynoides abnormis *sp. nov.* (cast)
(243a. L.6·2. W.2·5 × 15; Fig. 23a × 25).
(See page 30).

Fig. 24. Platycrossos sub-tumidus *sp. nov.* (mould)
(171. L.3. W.1·6 × 30; Fig. 24a × 50).
(See page 34).

Fig. 25. Polysitum minutus *sp. nov.* (cast)
(336a. L.2·2. W.1·2 × 30; Fig. 25a × 50).
(See page 42).

Fig. 26. Ademosynoides striatella *sp. nov.* (cast)
(16a. L.2·8. W.1·1 × 20; Fig. 26a × 35).
(See page 28).

Fig. 27. ,, magnifica *sp. nov.* (cast)
(199a. Elytron, L.8·5. W.2·9 × 10).
(See page 31).

Fig. 28. ,, magnifica *sp. nov.* (mould)
(199b. Elytron, L.8·5. W.2·9 × 10; Fig. 28a × 25).

NOTE.—Vertical marks indicating actual size on Plate 3 are 0·1 too large.

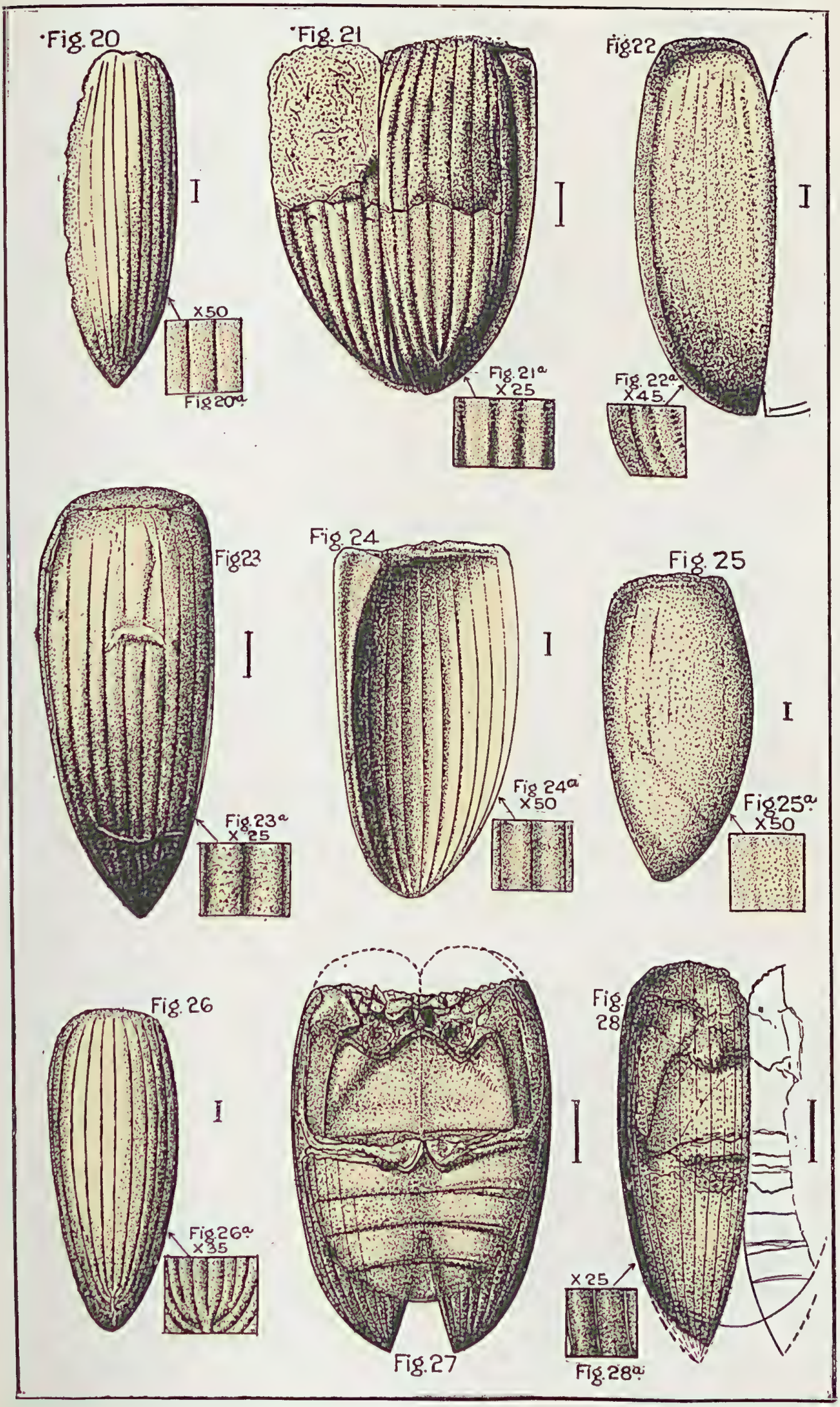
Fig. 20
x50
Fig 20a
Fig. 21
Fig. 21a
x25
Fig22
Fig. 22a
x45
Fig23
Fig. 23a
x25
Fig. 24
Fig. 24a
x50
Fig. 25
Fig25a
x50
Fig. 26
Fig.26a
x35
Fig. 27
Fig. 28
x25
Fig. 28a

PLATE 4.

Fig. 29. Simmondsia cylindrica *sp. nov.* (cast)
(87a. L.3. W.1·4 × 20; Fig. 29a × 40).
(See page 37).

Fig. 30. Elaterites transversus *sp. nov.* (cast)
(159b. L.6·5. W.2·7 × 12; Fig. 30a × 25).
(See page 45).

Fig. 31. „ subulatus *sp. nov.* (cast)
(263b. L.4·3. W.2. × 20; Fig. 31a × 50).
(See page 44).

Fig. 32. Shepherdia quadrivittata *sp. nov.* (cast)
(130a. L.11. W.3·4 × 8; Fig. 32a × 15).
(See page 39).

Fig. 33. Ulomites Willcoxi *Tillyard* (cast)
(50b. L.11. W.3 × 10; Fig. 33a × 25).
(See page 43).

Fig. 34. Simmondsia sub-piriformis *sp. nov.* (cast)
(135. L.3. W.1·2 × 30; Fig. 34a × 50).
(See page 36).

Fig. 35. Grammositum bilineatus *sp. nov.* (mould)
(136a. L.2·5. W.8 × 30; Fig. 35a × 50).
(See page 38).

Fig. 36. Polysitum punctatus *sp. nov.* (mould)
(153a. Elytron, L.6·9. W.2·7 × 12; Fig. 36a × 40).
(See page 40).

Fig. 37. Polysitum punctatus *sp. nov.* (cast)
(153b. L.7, W.5·5; × 12.)

NOTE.—Vertical marks indicating actual size on Plate 4 are 0·1 too large.

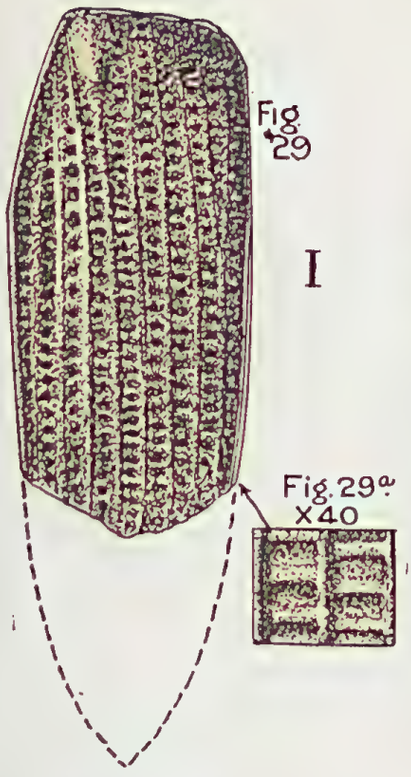
Fig. 29
I
Fig. 29a
x40

Fig. 30
I
Fig. 30a
x25

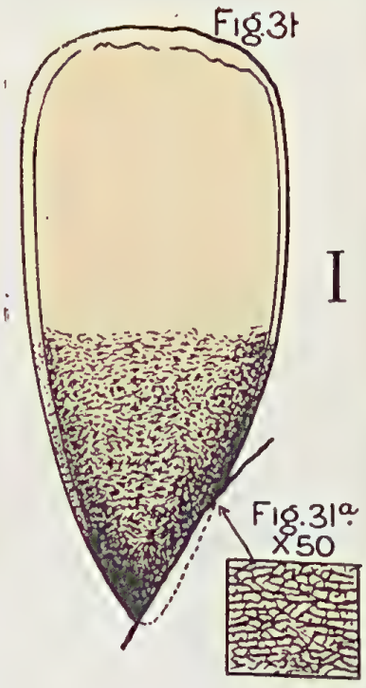
Fig. 31
I
Fig. 31a
x50

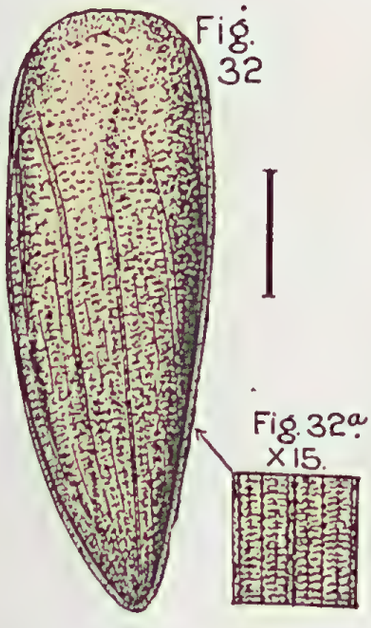
Fig. 32
I
Fig. 32a
x15.

Fig. 33
I
Fig. 33a
x25

Fig. 34
I
Fig. 34a
x50

Fig. 35.
I
Fig. 35a
x50

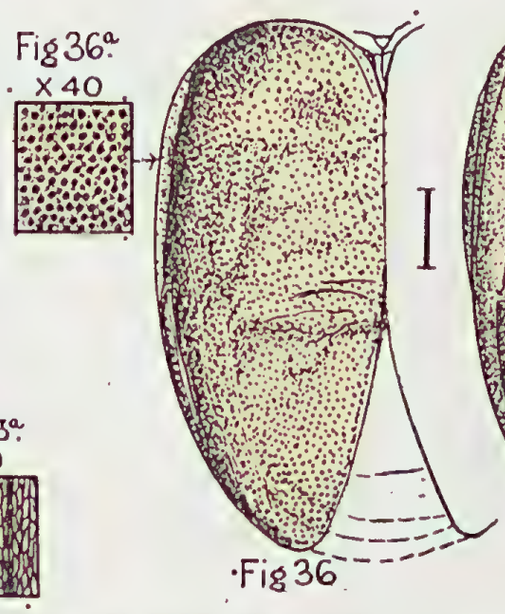
Fig 36a
x40
I
Fig 36

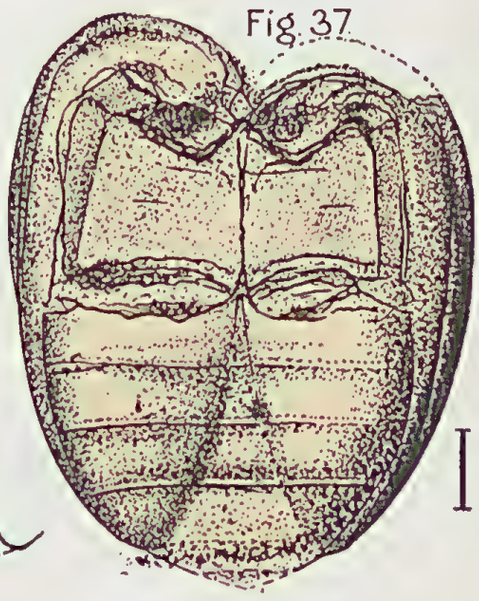
Fig. 37
I

PLATE 5.

Fig. 38. Reeveana major *sp. nov.* (cast)
(251a. L.5·4. W.1·9 × 15; Fig. 38a × 40).
(See page 48).

Fig. 39. Messostigmodera typica. *E. & O.* (cast and mould)
(61a, 61b. L.15. W.4·8 × 8; Fig. 39a × 12; Fig. 39b × 15).
(See page 56).

Fig. 40. Lobites granulatus *sp. nov.* (mould)
(183b. L.8·3. W.3 × 10; Fig. 40a × 25).
(See page 55).

Fig. 41. „ tuberculatus *sp. nov.* (cast)
(342a. L.5·8. W.1·8 × 15; Fig. 41a × 25).
(See page 54).

Fig. 42. Reeveana minor *sp. nov.* (cast)
(297a. L.3. W.1. × 30; Fig. 42a × 50).
(See page 50).

Fig. 43. Elaterium punctomarginum *sp. nov.* (cast)
(200b. L.7. W.2·2 × 12; Fig. 43a × 25).
(See page 46).

Fig. 44. Lobites trivittatus *sp. nov.* (cast)
(164a. L.12·5. W.3·4 × 8; Fig. 44a × 25).
(See page 53).

Fig. 45. Reeveana intermedia *sp. nov.* (cast)
(201b. L.3·6. W.1·4 × 15; Fig. 45a × 40).
(See page 49).

Fig. 46. Elaterium bipunctatum *sp. nov.* (cast)
(292a. L.4·4. W.1·4 × 20; Fig. 46a × 40)
(See page 47).

Note.—Vertical marks indicating actual size on Plate 5 are 0 1 too large.

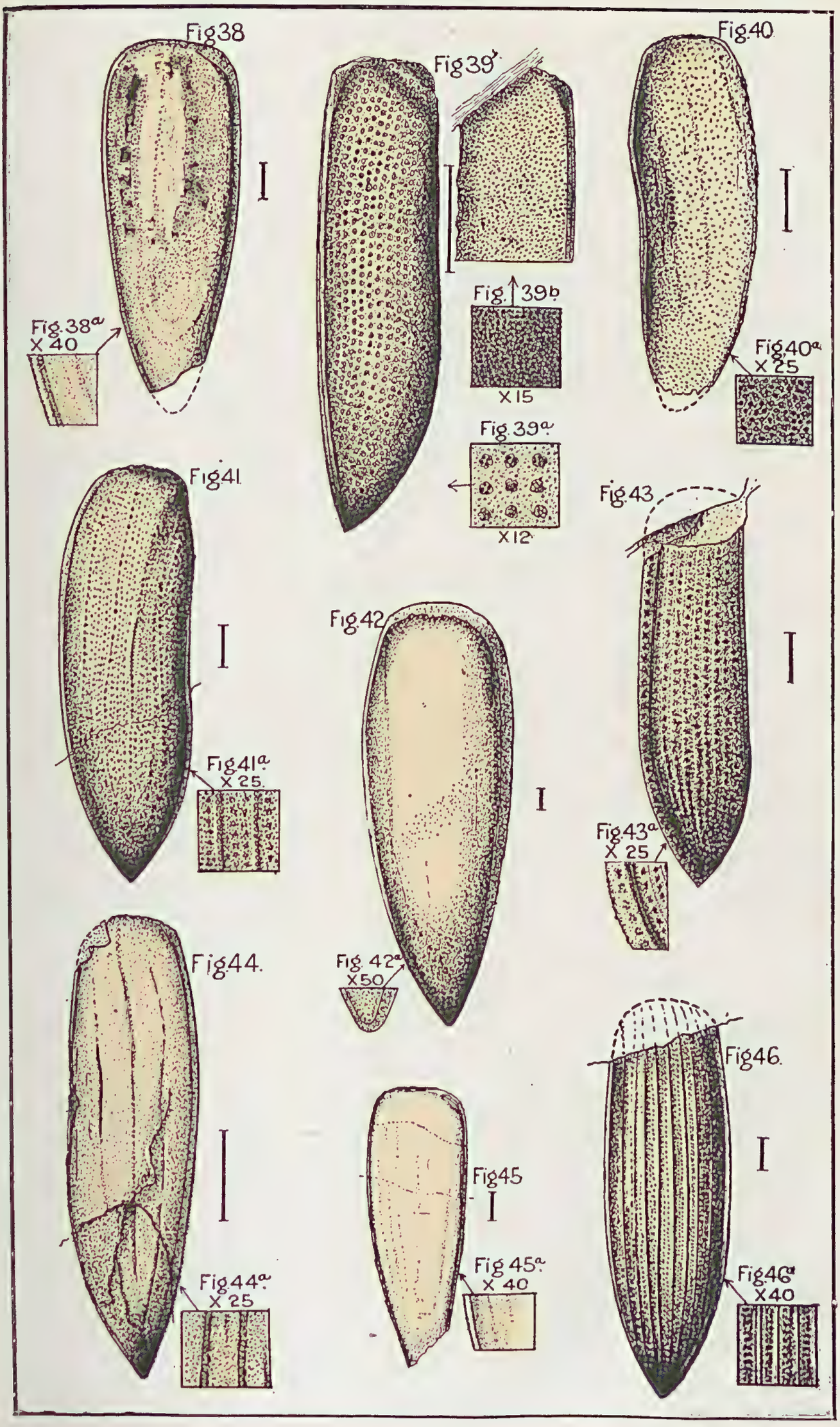
Fig38
Fig.38a
X 40
Fig39
Fig. 39b
X 15
Fig. 39a
X 12
Fig.40
Fig.40a
X 25
Fig41
Fig41a
X 25.
Fig.43
Fig.43a
X 25
Fig.42
Fig. 42a
X50
Fig.44.
Fig44a
X 25
Fig45
Fig 45a
X 40
Fig46.
Fig46a
X40

PLATE 6.

Fig. 47. Willcoxia magnopunctata *sp. nov.* (cast)
(261a. L.10. W.3·4 × 10; Fig. 47a × 25).
(See page 63).

Fig. 48. Mesothoris grandis *sp. nov.* (cast)
(54a. L.13. W.3·1 × 8; Fig. 48a × 20; Fig. 48b × 25).
(See page 61).

Fig. 49. „ tenuiclathrata *sp. nov.* (cast)
(313a. L.6·8. W.2·3 × 12; Fig. 49a × 40).
(See page 61).

Fig. 50. „ quadripartita *sp. nov.* (cast)
(349a. L.8. W.2·3 × 12; Fig. 50a × 40).
(See page 60).

Fig. 51. „ clathrata *Tillyard* (cast)
(48b. L.8. W.2·5 × 10; Fig. 51a × 30).
(See page 59).

Fig. 52. Leioodes pygmæum *sp. nov.* (cast)
(287a. L.1·2. W.0·4. × 30; Fig. 52a × 50).
(See page 69).

Fig. 53. „ planum *sp. nov.* (cast)
(348a. L.2·1. W.1·2 × 30).
(See page 69).

Fig. 54. Apheloodes obliquum *sp. nov.* (cast)
(143a. L.2. W.1·2 × 30).
(See page 72).

Fig. 55. „ rugosum *sp. nov.* (cast)
(236a. L.2·5. W.1·2 × 30).
(See page 71).

Note.—Vertical marks showing actual size on Plate 6 are 0·1 too large, with the exception of Figs. 53 and 55, which are 0·2 too large.

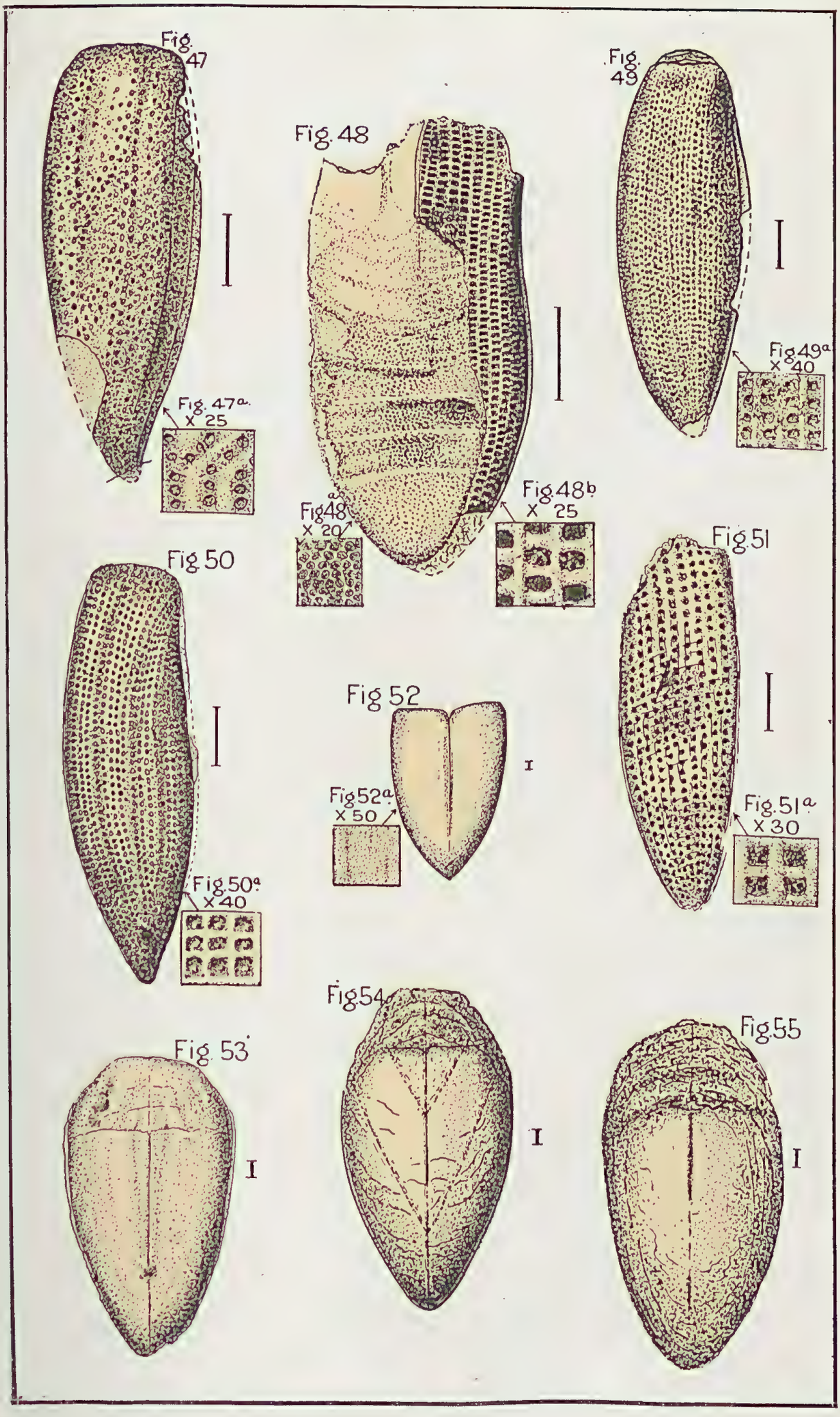
Fig. 47
Fig. 47a. x 25
Fig. 48
Fig. 48 x 20
Fig. 48b x 25
Fig. 49
Fig. 49a x 40
Fig. 50
Fig. 50a x 40
Fig. 51
Fig. 51a x 30
Fig. 52
Fig. 52a x 50
Fig. 53
Fig. 54
Fig. 55

PLATE 7.

Fig. 56. Tillyardiopsis granulata *sp. nov.* (cast)
(289a. L.6·8. W.2·6 × 12; Fig. 56a × 50).
(See page 66).

Fig. 57. „ tuberculata *sp. nov.* (mould)
(133a. L.7. W.2·7 × 12; Fig. 57a × 25).
(See page 65).

Fig. 58. „ variotubercula *sp. nov.* (cast)
(66a. L.6·5. W.2·5 × 12; Fig. 58a × 25).
(See page 67).

Fig. 59. Tryoniopsis granulata *sp. nov.* (cast)
(161a. L.5·7. W.1·8 × 15; Fig. 59a × 25).
(See page 52).

Fig. 60. Etheridgea australis *Handlirsch*
(S.4. L.3·6. W.1·4 × 20; Fig. 60a × 40).
(See page 68).

Fig. 61. Insect Fragments (350. L.8·5 × 6).

Fig. 62. „ „ (352. L.4·5 × 10).

Fig. 63. „ „ (353. L.5 × 5).

Fig. 64. „ „ (354. L.8 × 5).

Fig. 65. Tryoniopsis punctata *sp. nov.* (cast)
(250a. L.6. W.2·1 × 12; Fig. 65a × 25).
(See page 51).

Fig. 66. Insect Fragments (355. L.3 × 12).

Fig. 67. „ „ (356. L.7 × 6).

NOTE.—Vertical marks indicating actual size on Plate 7 are 0·1 too large.

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Fig. 56
Fig 56a
X 50

Fig. 57
Fig 57a
X 25

Fig 58
Fig58a
X 25

Fig59
Fig59a
X 25

Fig60
Fig 60a
X 40

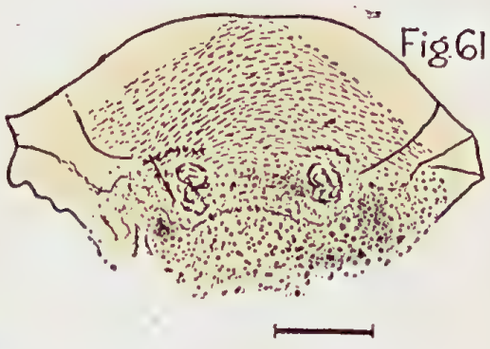
Fig 61

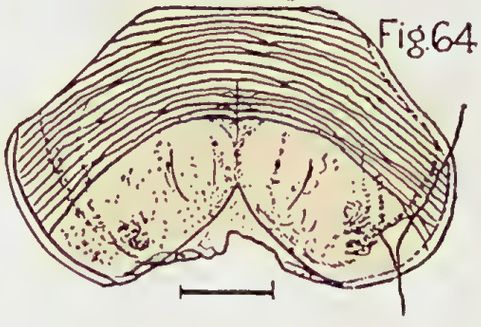
Fig 64

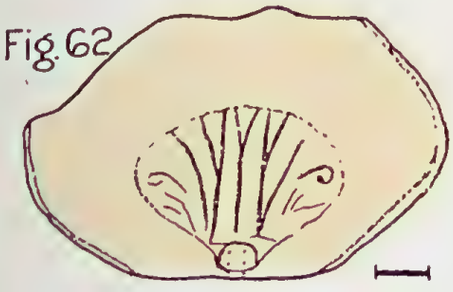
Fig 62

Fig 65
Fig 65a
X 25

Fig 67

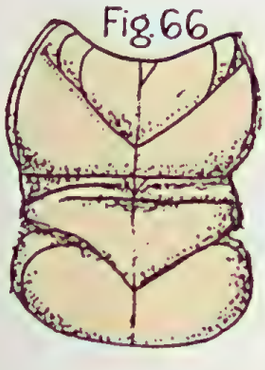
Fig 66

Fig 63

NATIONAL

[*From the Proceedings of the Linnean Society of New South Wales, 1917, Vol. xlii., Part 1, April 25th.*]

MESOZOIC INSECTS OF QUEENSLAND.

No. 1. Planipennia, Trichoptera, and the new Order Protomecoptera.

By R. J. Tillyard, M.A., B.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Plates vii.-ix., and seven Text-figs.)

Introduction.

The present paper deals with a portion of the very interesting fossil insects recently obtained from the Ipswich Beds by Mr. B. Dunstan, Chief Government Geologist of Queensland, to whom I am much indebted for the opportunity of studying such fine and, in many respects, unique material. This collection may be looked upon as the *third* collection of insect fossils made at Ipswich. The first, or Simmonds Collection, was made in 1890 by Mr. T. H. Simmonds, of Brisbane, and the specimens were described by Etheridge and Olliff in the same year.* In 1909, Mr. Dunstan made a second collection of insects from the same locality. These were sent to me for study in 1913, together with some fossil insects from other beds in Queensland and New South Wales. All these were dealt with in a paper published last year by the Queensland Geological Survey.† In this paper,

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*The Mesozoic and Tertiary Insects of New South Wales [and Queensland]. Geol. Survey of N.S.W. Memoirs, Palæontology, No. 7, pp. 9-22, two plates, 1890.

† Mesozoic and Tertiary Insects of Queensland and New South Wales. Queensland Geol. Survey, Publication No. 253, pp. 1-47, nine plates, six text-figs, 1916. (Stratigraphical Features, by B. Dunstan, pp. 1-13).

the total of *named* Ipswich fossils was brought up to twenty-two, representing the following Orders :—

Order.	Genera.	Species.
Blattoidea	1	1
Protorthoptera	2	2
Coleoptera	5	14
Odonata	1	1
Mecoptera	1	1
Lepidoptera	1	1
Protohemiptera	1	1
Hemiptera	1	1
Total, 8	13	22

In dealing with the stratigraphy of the Ipswich Beds,* Mr. Dunstan places the fossil insect bed as most probably Upper Triassic. The assemblage of insects so far revealed from these beds comprises a series of forms which, judged by the succession of strata in the Northern Hemisphere, range from Upper Carboniferous to Jurassic; some of the latter differing very little from forms still living in Australia to-day. It would seem to be useless to discuss, at present, the question of the exact age of the Ipswich fossil insect bed, since the data required for correlation with beds of known age are not yet available. What is of importance to entomologists, however, is the fact that the Ipswich Insects are undoubtedly, in most respects, more specialised than the Upper Carboniferous and Permian Insects of the Northern Hemisphere; while, at the same time, they are, on the whole, undoubtedly more archaic than the assemblage of forms known from the Lower Lias. To give a striking example, the dragonfly *Mesophlebia antinodalis* Tillyard, from Ipswich, is intermediate between the Carboniferous Protodonata, in which no nodus was formed, and the Liassic Odonata, in which the same structure of the wing was completely formed. In other words, the intermediate condition of nodus-formation, seen in

* *Op. cit.*, No.253, pp.1-13.

Mesophlebia, is the condition that would be expected to be found in Triassic dragonflies from the Northern Hemisphere, if such were available. Similarly, it will be seen that the Caddis-flies described in this paper are definitely more archaic than the known Liassic forms. The value of the Ipswich fossils, therefore, lies in this, that they are gradually filling up the gaps left in Insect Phylogeny, by the unfortunate hiatus in the Trias of the Northern Hemisphere. Whether we designate these fossils as Triassic or Trias-Jura matters little, in comparison with the fact that they contain, amongst their number, forms which, if they were ever present in the Northern Hemisphere, could only have been Triassic.

Chiefly as a result of the interest attached to the specimens described by me from Mr. Dunstan's 1909 collection, further work was carried on at Ipswich in 1915-16. Owing to the sharp angle of dip, the fossil bed cannot be followed down very far without removing a great deal of overburden. Under Mr. Dunstan's close supervision, this has been carefully carried out by Mr. Wilcox, the shale being removed in large pieces to the Geological Survey in Brisbane, where it was delaminated with great care. The rock taken from some distance below the originally exposed surface has proved hard, and not easily delaminable. It would also appear to be much poorer in insect fossils than the rock nearer the surface; but this may be, in reality, only due to the difficulty of splitting it up sufficiently. The result of the examination of a considerable quantity of this rock has been the formation of the new collection of Ipswich fossil insects, which I hope to deal with in this series of papers. Mr. Dunstan informs me that the total number of specimens approaches two hundred. Most of these, however, are either Coleopterous elytra, Blattoid tegmina, or fragments of wings that do not merit a name; so that the number of recognisable new forms will be very much smaller. The study of these forms is a matter of great difficulty, requiring much care and maturity of thought. With an entirely new type of wing, it is much wiser to withhold publication for at least a year, while the peculiarities of the venation can be turned over and over in one's

mind, and a matured judgment given. Thus I have found it impossible to offer a complete account of these fossils in a single paper, without serious delay in the writing of it. The alternative is to deal with each Order separately, and to publish the results in a series of shorter papers. This I have determined to do. The present paper, dealing with the Orders Planipennia and Trichoptera, and the new Order Protomecoptera, is the first of this series.

Order NEUROPTERA PLANIPENNIA.

Family Prohemerobiidæ Handlirsch.

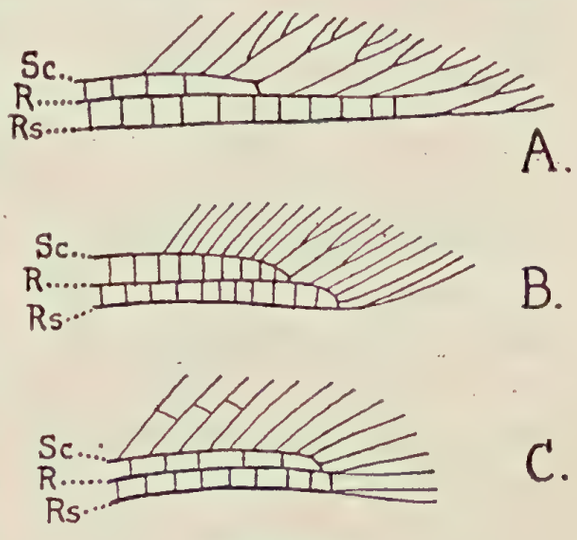
Genus Protopsychopsis, n.g. (Plate vii., fig.3).

Wings broad, moderately pointed, with a large number of forked apical veins. Costal margin moderately broad (not as broad as in *Psychopsis*), with numerous costal cross-veins, some forked. Sc and R separated by cross-veins; distally, Sc and R approach close to one another some little distance before the apex, and are there joined by the last of a series of cross-veins; at this point, the end of Sc turns obliquely upwards as a slanting forked vein to the costal border, while R runs almost straight on, to end somewhat above the apex. R and Rs more widely separated than are Sc and R; numerous cross-veins traverse the space between them, and continue well beyond the last cross-vein from Sc to R. Rs gives off at least twelve branches (S_1-S_{12}), running longitudinally through the wing at a slight inclination from Rs, and subparallel to one another. The cross-veins between these branches of Rs are exceedingly delicate, and only discernible in strong oblique light. There are two rows of gradate veins arranged into almost complete transverse lines across the wing; the more distal series lies below the extreme ending of Sc on the wing-margin, and runs from R down to S_{12}; the more proximal series lies twice as far from the apex as does the former series, and runs from S_2 to S_{12}. Between these lies an intermediate series, forming a set of steps from S_2 to below S_{12}; this series starts close to the outer series, then curves away from it, and ends up below S very close to the inner series.

Some other scattered cross-veins are present, but are not easily discernible. [Rest of wing missing].

Genotype, *Protopsychopsis venosa*, n.sp.

This genus would appear to be very closely allied to *Brongniartiella* Handlirsch, and *Mesopsychopsis* Handlirsch, both Jurassic forms, but differs from them in possessing a broader costal field apically, and in the presence of the three gradate series. It is also undoubtedly closely allied to our Australian genus *Psychopsis*, which is one of the most archaic forms of Planipennia still existing. The arrangement of the gradate series, some as complete straight lines across the wing, and some as step-veins, is exactly that found in *Psychopsis*. *Protopsychopsis*, however, differs from *Psychopsis* in not having the costal field unduly widened, and in lacking (as far as we can see in the fragment preserved) the multiple forkings of the costal cross-veins, and their breaking up by cross-veinlets, which is characteristic of *Psychopsis*. Also, in *Psychopsis*, Sc and R stand further apart, and there is a linking-up of Sc, R, and Rs distally by two strong cross-veins, which close off the closely-veined marginal area from the three strong main veins with their intermediate cross-veins. In *Psychopsis illidgei*, however, this arrangement remains only partially completed, so that *Protopsychopsis venosa*, *Psychopsis illidgei*, and *Ps. elegans*, for instance, form (for this character) a phylogenetic series, as shown in Text-fig. 1.



Text-fig. 1.*

There can be little doubt that our recent genus *Psychopsis* is a direct descendant from a form similar to *Protopsychopsis*.

* Phylogeny of the distal ends of Sc, R, and Rs in *Protopsychopsis* and *Psychopsis*. A, oldest stage (*Protopsychopsis venosa*, n.g. et sp.). B, intermediate stage (*Psychopsis illidgei* Froggatt). C, final stage (*Psychopsis elegans* Guér.), with the three veins strongly linked together by cross-veins.

That being so, it becomes questionable whether Handlirsch's family *Prohemerobiidæ* ought to be retained, especially as the name is misleading, and suggests that they were ancestors of the *Hemerobiidæ*, with which they almost certainly had nothing to do. All these forms might well be classed as *Psychopsidæ*.

PROTOPSYCHOPSIS VENOSA, n.sp. (Plate viii., fig.3).

Characters as for the genus. [Only the apical portion of the wing preserved]. All the venation beautifully preserved, except for the more basal portion above Sc, which is indistinct. The furrows between the sectors are very clearly shown, but have not been drawn in the plate, in order to keep the venational scheme quite obvious.

Measurements of fragment: greatest length 9·5 mm., greatest breadth 7·3 mm. The complete wing would probably be 30 mm. long, and 15 mm. across at its greatest width.

Type, Specimen No. 160*a*. (Coll. Queensland Geol. Survey).

Order TRICHOPTERA.

Family MESOPSYCHIDÆ, fam.nov. (Plate vii.).

Characters of Forewing.—A long pterostigmatic region present, not strongly chitinised, closed off proximally by a cross-vein between Sc and R. Costal space with extra cross-veins present. R_1 joined to R_2 near apex by means of a cross-vein or oblique posterior branch. All five apical forks present, *and at least one of them divided into two or more separate cells, by cross-veins not present in recent forms.* Apical fork 2 with wing-point present. Discoidal and median cells present, completely closed, separated by an extra closed (subdiscoidal) cell between R_5 and M_1. Thyridium-cell present or absent. Cubital veins variable. [Anal area not preserved].

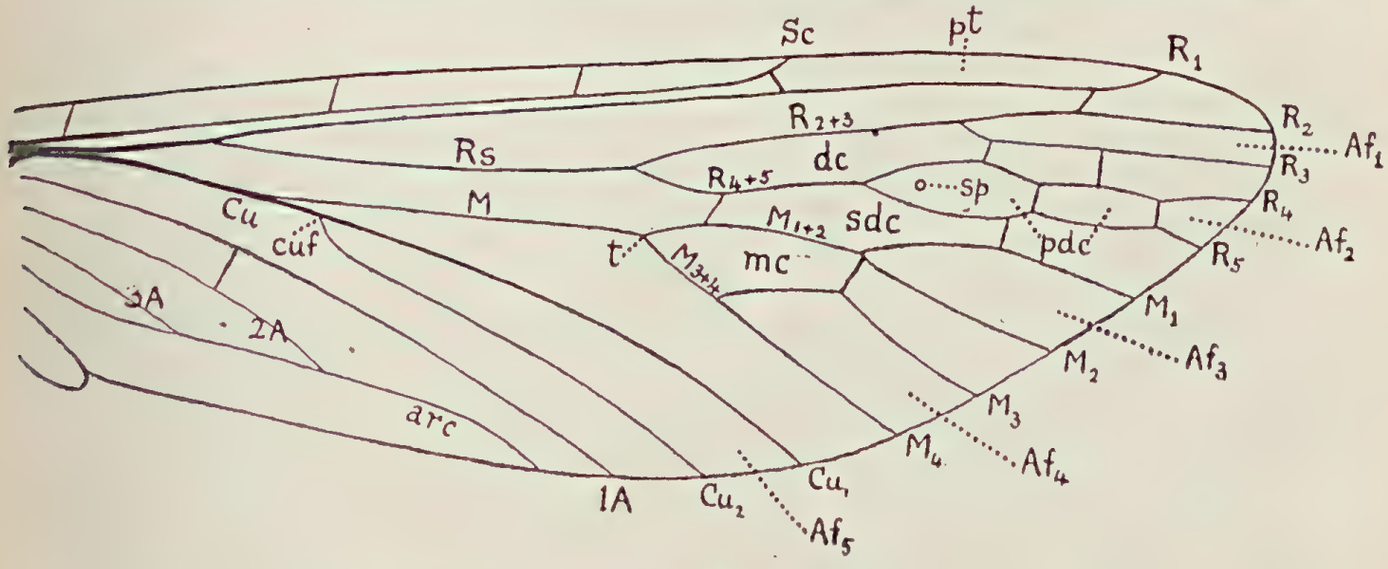
With the above definition of the family, the two beautiful forewings represented in the present collection may be placed in two separate genera as follows:—

Thyridium-cell absent; apical fork 2 divided into three polygonal cells, by means of two cross-veins and zig-zagging of R_4 and R_5..... ..... Genus MESOPSYCHE, n.g.

Thyridium-cell present; apical fork 3 divided into two cells. .... Genus TRIASSOPSYCHE, n.g.

Genus MESOPSYCHE, n.g. (Text-fig.2, and Plate vii., fig.1).

To the characters of the family, as given above, we add the following generic characters :—Two costal cross-veins preserved (probably three or more in complete wing). Sc and R run parallel and very close together. Pterostigmatic region long and narrow, the proximal cross-vein descending obliquely from Sc at its distal end. R_1 joined to R_2 by a single backwardly



Text-fig.2.

Restoration of forewing of *Mesopsyche triareolata*, n.g. et sp., (×7) For lettering, see Explanation of Plates.

slanting cross-vein above Af.1. Discoidal cell (*dc*) elongated, hexagonal, with Af.1 and Af.2 both sessile upon it. Beyond distal side of *dc*, an extra cross-vein connects R_3 with R_4. In Af.2, three separate cells (Text-fig.2, *pdc*) are formed by means of two connecting cross-veins and weak zig-zagging of R_4 and R_5. Wing-point (*sp*) placed in Af.2 not far from the forking of R_4 from R_5. Subdiscoidal cell (*sdc*) elongated, hexagonal. Median cell (*mc*) an irregular pentagon, with Af.4 strongly sessile upon it, Af.3 just arising from its upper distal angle. Thyridium (*t*) placed directly under the main forking of Rs. Thyridium-cell (*tc*) absent. Cu apparently fused with M basally, *cuf* placed well basad (under second costal cross-vein) and consequently Af.5 of great length.

So much of this wing is preserved, with the details of venation beautifully clear, that there is no difficulty in restoring it to

its complete form. This I have done in Text-fig.2. The only doubtful point is as to the form of the anal area, which I have restored on the typical Trichopterous plan of a long curved arculus (*arc*), with veins 2A and 3A falling obliquely upon it from above.

Genotype, *Mesopsyche triareolata*, n.sp.

MESOPSYCHE TRIAREOLATA, n.sp.

(Text-fig.2, and Plate viii., fig.1).

Forewing elongated, rather narrow, the anterior border scarcely curved at all right from base to tip. Distal half of wing tapering to a bluntly pointed tip. Af.1 at apex of wing, Af.2 well below it.

Greatest length of fragment, 13 mm.; greatest breadth, 5·8 mm. Total length of restored wing, about 16·5 mm. Probable expanse of wings in the original insect, 33 mm.

Type, Specimen No.110 (Coll. Queensland Geol. Survey).

A discussion of the relationship of the genus *Mesopsyche* with recent forms will be found on p. .

Genus TRIASSOPSYCHE, n.g. (Text-fig.3, and Plate vii., fig.2).

To the characters of the family *Mesopsychidæ*, we add the following:—Numerous costal cross-veins present (three preserved distally in a short space). Sc and R not close together, subparallel. Towards its distal end, Sc throws off an oblique cross-vein to C, and takes a short sharp bend downwards to the point at which it is connected to R_1 by a cross-vein; it then continues in a gentle curve onward, finally uniting with C at a point lying nearly half-way along the total length of the pterostigmatic region (as measured from the proximal cross-vein to apex of R_1). Consequently, pterostigmatic region very long, of irregular shape, narrowed proximally and broadened out in middle. R_1 connected with R_2 by a cross-vein descending from middle of *pt* on to *dc*. R_1 also forks distally, the lower branch running slantingly into R_2 well before the margin of the wing. Discoidal cell (*dc*) elongated, hexagonal, distinctly broader than in *Mesopsyche*, but of very similar general shape, with Af.1 and Af.2 both sessile

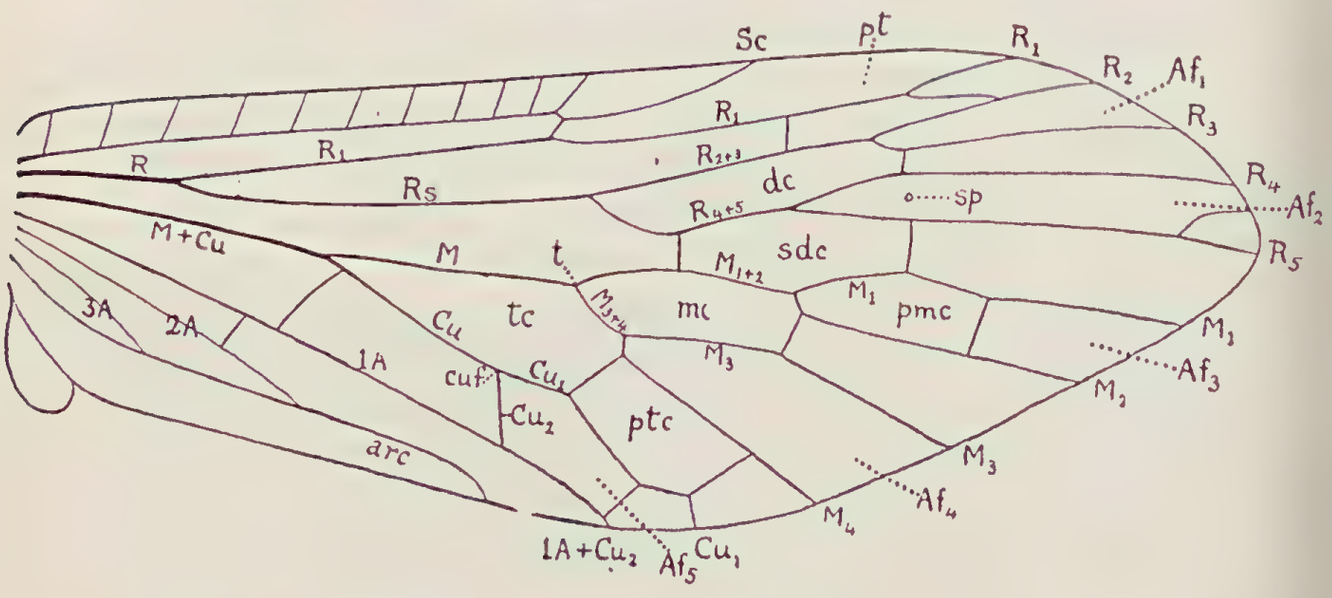
upon it. Apparently a small extra apical forking of R_5 in Af.2. Beyond *dc*, no extra cross-vein between R_3 and R_4. No cross-veins in Af.2; the wing-point (*sp*) not clearly shown, but apparently present just below the distal side of *dc*. Subdiscoidal cell (*sdc*) present, shaped as in *Mesopsyche*, but considerably broader. Median cell (*mc*) present, of more regular shape than in *Mesopsyche*. Af.4 strongly sessile upon it. Af.3 either slightly sessile, or just arising from its upper distal angle (as in *Mesopsyche*). Af.3 divided into two cells by an extra cross-vein joining M_1 and M_2. Thyridium (*t*) placed directly under the main forking of Rs (as in *Mesopsyche*). Thyridium-cell (*tc*) present, elongated, pentagonal, closed off distally by a strong cross-vein from M_4 to the weakly zig-zagged Cu_1. A second cross-vein, parallel to this, separates off a post-thyridial cell (*ptc*) between M_4 and Cu_1. Only the distal portion of Cu is preserved; apparently Cu_2 fuses with 1A not far from the wing-border, and the very irregularly formed Af.5 is divided into two cells by means of a cross-vein dropped from Cu_1 obliquely on to $1A + Cu_2$ almost at the wing-margin.

Genotype, *Triassopsyche dunstani*, n.sp.

Though not so well preserved as the wing of *Mesopsyche*, yet this fossil shows most of the details necessary for a reconstruction to be possible. Several of the cross-veins are not completely preserved (see Plate vii., fig.2). There is a roughly raised linear mark extending between M-M_4 and Cu-Cu_1, which at first sight looks as if it might be covering a main vein. Fortunately, as Cu_1 is always a well-marked convex vein, it was possible to determine this question definitely. For, in the fossil, the vein marked Cu_1 is definitely convex, and hence there can be no main vein between it and M-M_4. The vein marked 1A is so determined because, at the point where it is broken off proximally in the fossil, it is definitely *diverging proximad* from Cu. Had it been converging, it would have been determined as Cu_2, and the vein marked Cu_2 in the figures would have been considered a specialised cross-vein.

In Text-fig.3, I have attempted the restoration of this fine wing, which must be reckoned among the largest Trichopterous

wings known to have existed outside the *Phryganeidæ* and *Limnephilidæ*. The provisional restoration of the missing anal area is drawn on the same lines as that for *Mesopsyche*.



Text-fig.3.
Restoration of forewing of *Triassopsyche dunstani*, n.g. et sp., ($\times 5\frac{3}{4}$).
For lettering, see Explanation of Plates.

TRIASSOPSYCHE DUNSTANI, n.sp. (Text-fig.3, and Plate vii., fig.2).

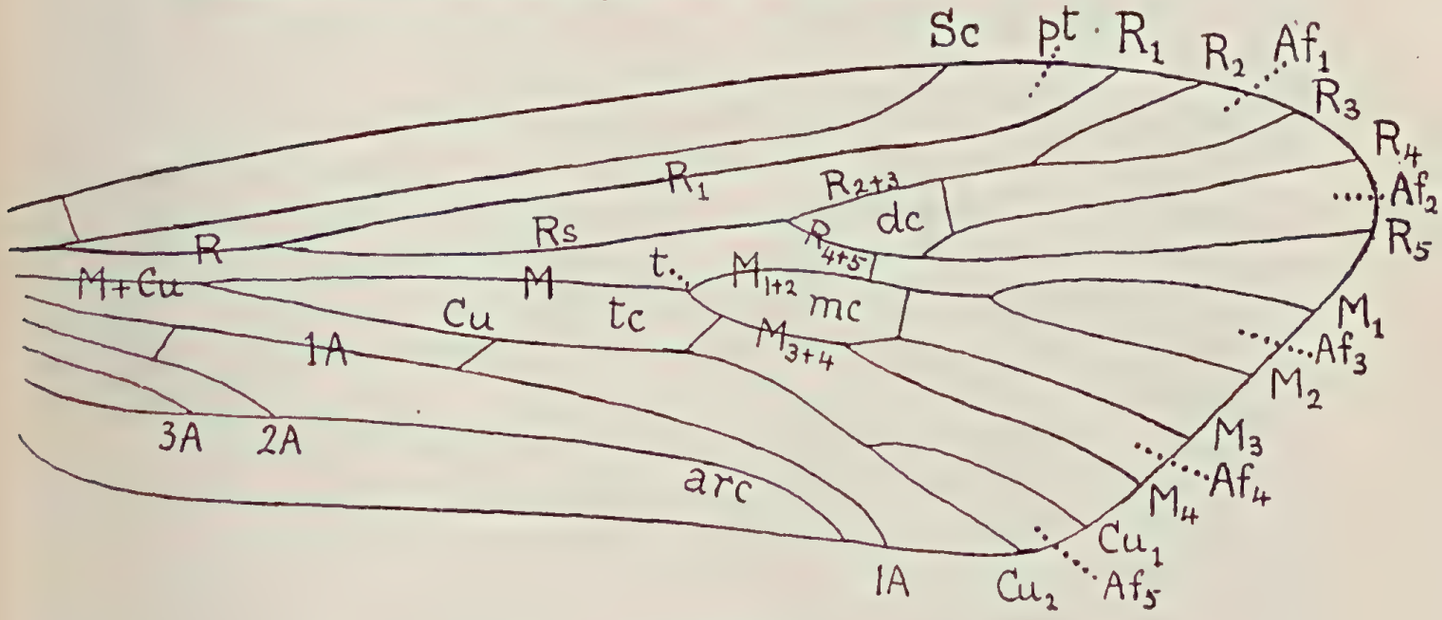
Forewing elongated, moderately broad, both anterior and posterior borders well curved distally. Apex moderately pointed. Af.2 at apex of wing, Af.1 placed well before it.

Greatest length of fragment, 13·5 mm.; greatest breadth, 6·8 mm. Total length of restored wing, about 19 mm. Probable expanse of wing in the original insect, 40·5 mm.

Type, Specimen No.128a. (Coll. Queensland Geol. Survey).

These two fossil wings, *Mesopsyche* and *Triassopsyche*, are of very great interest, not only because they are the oldest fossil Trichoptera yet discovered, but also because they are, in actual wing-venational structure, very much more archaic than anything yet discovered in this Order. The Liassic *Necrotauliidæ*, described from the beds of Dobbertin (Mecklenburg) and Aust (England), are a series of very small wings, ranging from 3 mm. to 7 mm. in length, the forewings possessing either four or five apical forks, the hindwings four. Most of these wings have no cross-veins, and, consequently, no closed cells of any kind. One

or two, however, have a closed discoidal cell, and one of the largest forms, *Necrotaulius major* Handlirsch, probably possessed a median cell as well. This latter form would come nearest to our Ipswich fossils, since it agrees with them in having both Af.1 and Af.2 sessile upon *dc*, and Af.4 sessile upon *mc*, while Af.3 appears to be just sessile upon the upper distal end of the same cell. In all other respects, the *Necrotauliidæ* must be considered as considerably specialised by reduction, and loss of the archaic cross-venation inherited from Panorpoid ancestors.



Text-fig. 4.

Forewing of *Hydropsyche* sp., for comparison with Text-figs. 2 and 3. (After Ulmer).

Thus our new fossils are seen to stand in a much closer ancestral relationship with some of the more archaic present-day families than they do with the Liassic *Necrotauliidæ*; and it seems exceedingly probable that we have in Australia, alive to-day, genera directly descended from them. Unfortunately, the Australian Trichopterous fauna, though both abundant and remarkable, has so far been hardly touched,* so that we are compelled to make a more general comparison with known forms from other parts of the world. On these lines, I must indicate

* Only thirteen species have, so far, been described from Australia and Tasmania; but I have, in my own collection alone, nearly a hundred species, many being closely related to New Zealand forms.

the *Hydropsychinæ* as being the closest existing relatives of the *Mesopsychidæ*, both in the general shape of the forewing, the relationships of the main veins and branches *inter se*, and, in particular, the structure of the discoidal and median cells (*cf.* Text-figs.2, 3, 4).

If we compare the forewings of *Mesopsyche* and *Triassopsyche* with that of *Hydropsyche* (Text-fig.4), we shall notice the following resemblances and differences :—

(1) The general shape of *Hydropsyche* closely resembles that of *Triassopsyche*. *Mesopsyche* has a wing distinctly narrower than that of most *Hydropsychinæ*.

(2) *Hydropsyche* has lost all but the most basal of the costal cross-veins. There are, however, a number of recent genera of *Hydropsychinæ* possessing one or more extra costal cross-veins, e.g., *Chloropsyche*, *Ethaloptera*, *Amphipsyche*, *Phanostoma*, and *Polymorphanisus*. We may see in this a persistent archaic character handed down from ancestors closely resembling our two Ipswich genera.

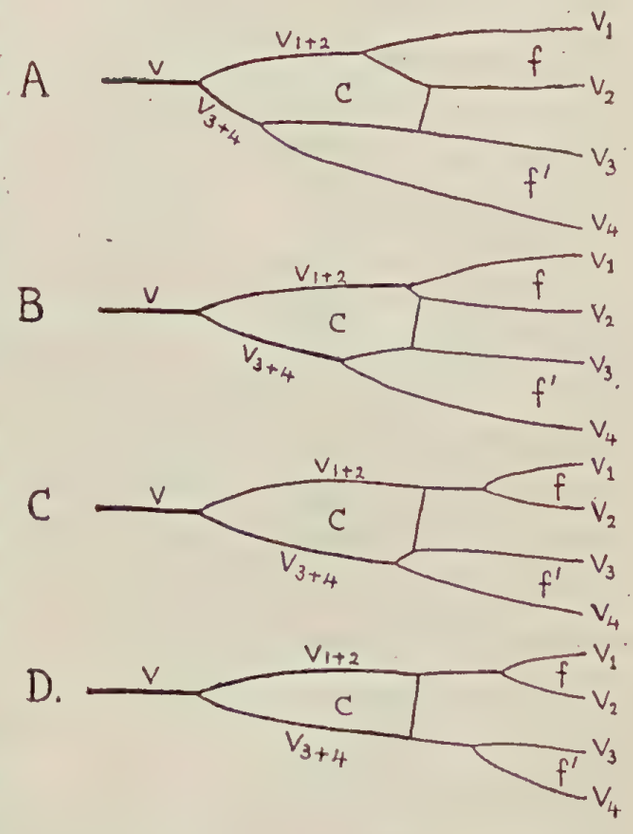
(3) In *Hydropsyche*, the pterostigmatic area has become reduced and left incomplete proximally, by loss of the cross-vein below Sc. There are other genera of *Hydropsychinæ*, however, in which the cross-vein still persists (e.g., *Smicridea*).

(4) In *Hydropsyche*, Af.1 is no longer sessile upon *dc*, but has become distinctly stalked. Similarly, Af.3 is stalked from *mc*. Af.2 and Af.4 remain sessile upon *dc* and *mc* respectively, but not so completely as in the *Mesopsychidæ*. The character of possessing all four forks (Af.1-Af.4) sessile upon their respective cells is retained in a few recent genera, e.g., *Anisocentropus* in the *Calamoceratidæ*. In this latter genus, the structure of *dc* and *mc* and the forks arising from them very closely resembles that seen in *Triassopsyche*. The importance of this character, from a phylogenetic standpoint, may perhaps be emphasised by a phylogenetic diagram (Text-fig.5), in which all stages are shown, from the original archaic formation (A) down to the most advanced cænogenetic form (D), in which the two forks are stalked. In this diagram, the cell may be taken either as *dc* or *mc*; if the former, the upper fork is Af.1, the lower Af.2; if

the latter, the forks are Af.3 and Af.4 respectively. Besides this direct phylogenetic line, one or both of the forks may be lost *at any stage of the reduction*, by suppression of a branch. Thus, in the *Leptoceridæ*, *Oecetis* (N. Zealand) keeps *dc* present and Af.1 sessile, but Af.2 is completely lost; while the allied *Triplectides* (Australia) has progressed one stage further, having Af 1 strongly stalked.

(5) The thyridium-cell (*tc*) is present in *Hydropsyche* and *Triassopsyche*, absent in *Mesopsyche*. If, however, the latter had a single cross-vein from M_{3+4} to Cu_1, its *tc* would closely resemble that of *Hydropsyche* in shape and position.

(6) *The excess cells of Mesopsychidæ:* here the *Mesopsychidæ* offer a contrast, not only with the *Hydropsychinæ*, but with all recent Trichoptera. In the marine caddis-fly, *Philanisus plebejus* Walker (Australia and N. Zealand), there is a small subdiscoidal cell which may be comparable with the large *sdc* of *Mesopsychidæ*; but, in nearly all recent genera, there is nothing comparable with it. The three post-discoidal cells (*pdc*) of *Mesopsyche*, the post-median cell (*pmc*) of *Triassopsyche*, and the complicated cell-



Text-fig. 5.*

* Phylogeny of a principal cell in the wings of Trichoptera. A, oldest stage, with both end-forks sessile upon the cell. B-C, successive reduction-stages towards D, the cænogenetic stage, with both end-forks stalked. At any stage, the cross-vein completing the cell distally may be lost, or one of the forks may be reduced to a simple vein.—*c*, the cell; *v*, the main vein, v_{1+2}, v_{3+4}, its branches enclosing the cell basally; v_1, v_2, the branches enclosing the upper fork, *f*; v_3, v_4, the branches enclosing the lower fork, *f'*; (*c* represents either *dc* or *mc*; *v*, either Rs or M).

formation distally upon Cu_1 in the same genus, appear to be the archaic remains of an originally denser cross-venation, long since lost, and not seen in any recent forms.

Order PROTOMECOPTERA, ordo nov.

Large insects, with venation of the same type as the Mecoptera, but much denser. The whole of the wing-membrane, except the pterostigma, is covered with an abundant meshwork of polygonal cellules, at the junctions of which are developed strong hairs, so that the whole of the wing is densely hairy. Hairs are also present upon the main veins and transverse veins.

Between Sc and anterior border of wing, a strong costal vein (C) is present, supported above and below by cross-veins, and ending at least half-way along the anterior border. Upon the apical border of the wing, between the end of R and the end of Cu_1, no less than *seventeen* longitudinal veins abut (only *nine* in Mecoptera). Venation of fore- and hindwings closely similar. Apical half of wing with many elongated polygonal cells of large size present (five- to seven-sided). A smooth membranous pterostigma present upon the distal end of R in both wings, and extending into the space between R and Rs, where it ends posteriorly upon a distinct *pterostigmatic furrow* (*ptf*), parallel to Rs.

The principal differences between the Orders Mecoptera and Protomecoptera may be best exhibited in the following table:—

	Protomecoptera.	Mecoptera.
Size	Expanse 100 mm. or over	Expanse 15-50 mm.
Costal vein	present	absent
Fine polygonal network of cellules	present	absent
Hairs	present, both on veins and membrane	absent, or only very minute hairs present
Number of longitudinal veins abutting on apical portion of wing-margin, between R and Cu_1	seventeen	nine
Number of apical forks in same area	eight	five

This new Order is proposed for the reception of a very remarkable fossil from the Ipswich beds, represented by fore- and hindwings, very beautifully preserved. The insect forms the direct connecting link between the Palæozoic Palæodictyoptera on the one hand, and the recent Mecoptera on the other. The Palæodictyopterous character is seen in the primitive, almost Blattoid, scheme of venation (which is, of course, preserved also better in Mecoptera than in any other recent Order, but with great reduction), and the presence, in its last stage of evolution, of the dense reticular meshwork of polygonal cellules so characteristic of this ancient Order. In the Protomecoptera, as exemplified by this Ipswich fossil, the development of hairs upon both veins and membrane is very pronounced; and the wings exhibit, in a remarkable manner, the method by which hairs first appeared upon the wing-membrane; just as *Mesogereon*, another Ipswich fossil, exhibits the first formation of tubercles in the Hemipteroid wing. Another exceedingly archaic character, long since lost in most insect-wings, is the presence of a true *costal vein*, not fused with the costal border of the wing.

The Mecopterous characters are very obvious, for the wings are clearly built upon the Panorpid venational plan. The essentials of this are—

(1) Close similarity between fore- and hindwings, with only slight differences in venation.

(2) Symmetrical dichotomous branchings (bilateral forks) of Rs and M, as opposed to the unilateral or unsymmetrical forkings of these same veins seen in the Odonata, Neuroptera, etc.

(3) Transverse veins few, and so arranged as to support the bilateral forks. Thus are formed the typically Panorpoid *elongated polygonal cells* of large size, and varying from five to seven sides. The true Mecoptera have, typically, *twelve* of these cells lying completely within the wing between Rs anteriorly and M-M_4 posteriorly, but the number may be reduced by suppression of cross-veins. In some fossil Mecoptera, the number may be greater. In the Protomecoptera, there are *twenty* of these same cells.

In view of the fact that some of the present-day Mecoptera,

(e.g., *Panorpodes*, and a new genus recently discovered in Australia) have generalised mouth-parts, with only the barest beginnings of the tendency towards the formation of the prominent *beak*, usually supposed to be typical of the Order, we may reasonably claim that the mouth-parts of the Protomecoptera were normally mandibulate, though they are not actually preserved for us in the fossil state.

It is important to bear in mind that true Mecopterous wings, allied to the Australian genus *Tæniochorista*, have already been found in the Ipswich beds. Further, I am able to state definitely that very similar forms occur in the Permo-Carboniferous strata of Newcastle, N.S.W., and are being studied by me at the present time. None of these wings show the Protomecopterous characters seen in the fossil under consideration. This is a strong argument for the erection of a new Order. For it is evident that these Protomecopterous wings are far older, evolutionarily, than are the Mecopterous wings of the Permo-Carboniferous. Since, however, the Mecoptera must have descended, by reduction, from Protomecopterous forms, it follows that our Ipswich fossil must be a representative of a much older race, that not only existed side by side with the true Mecoptera in Permo-Carboniferous times, but *preceded them* in the Carboniferous. That is, the dichotomy between Protomecoptera and Mecoptera took place in Palæozoic times. Thus the erection of a new Order is justified on palæontological as well as on morphological grounds; for the differences between the two Orders are, both in time and degree, just such as Handlirsch has relied upon in forming most of his other fossil Orders.

We must remember, too, the composite character of the Ipswich fauna. I have already shown that Protorthoptera exist there alongside forms differing scarcely at all from insects alive at the present day, and that Protohemiptera and Homoptera lived side by side. Alongside a true Dragonfly, there has recently been found another new type that is undoubtedly a Protodonate! Thus there is nothing surprising in the existence of Protomecoptera and true Mecoptera side by side in these fossil beds.

Family ARCHIPANORPIDÆ, fam.nov.

Characters as for the Order, with the following additions Large insects, with a wing-expanse of 100 mm. or over. Pterostigma longer and narrower in hindwing than in forewing, not reaching proximally to Sc in either wing. Sc ends up on the anterior margin of the wing beyond half-way in both wings, but not so far in hindwing as in forewing. Cu_1 ends up on posterior margin a little before the level of the pterostigma in forewing, considerably before the same level in hindwing. Cu_2 probably present in both wings.

Genus ARCHIPANORPA, n.g.
(Plate viii., figs.4-6; Plate ix.)

Characters as for the family, with the following additions. Forewing broadest at or near pterostigma, hindwing broadest just before half-way, and having the apical third distinctly narrower than in forewing. Pterostigma of forewing rather short, irregularly shaped, with R arching up within it, convexly to the wing-border. Pterostigma of hindwing long and narrow, with R running almost straight through it.

Genotype, *Archipanorpa magnifica*, n sp.

ARCHIPANORPA MAGNIFICA, n.sp. (Plate viii., figs.4-6; Plate ix.)

This species is represented by two fine fossil wings, Nos. 106*a* and 120*a*, in the Queensland Geological Survey's Collection. Of these, No.106*a* is the better preserved specimen. It shows the whole of the wing from the apex to a level slightly distad from the origin of Rs. A transverse fracture of the rock has destroyed the base. The total length of this fragment is 33 mm., its greatest breadth 13 mm. The specimen represents a *cast* of a *left hindwing*.

No.120*a* is not so well preserved, there being two pieces cut out from the posterior margin, and two slight cracks running across the wing. The main fracture, which appears to be the same break that cut off the base of No.106*a*, (the two wings were found very close together) has cut off this wing more obliquely, and a little further from the base (see Plate viii., figs.4-5). The

total length of the fragment is 30 mm., its greatest breadth 14 mm. It represents the *mould* of a *right forewing.*

The method of determining what wing a given specimen represents may be briefly stated as follows. In the Panorpoid wing, there are two strong and highly convex veins, viz., R and Cu_1. If such a wing became fossilised, and a cleavage of rock later on reveals it, there should be a *cast* of the wing showing R and Cu_1 as high convex ridges, and a *mould* showing them as concave furrows. In the mould, also, *all* the veins will be concave grooves *in themselves;* whereas, in the cast, they will be convex rods, quite apart from whether they stand high up on ridges of the wing (as R and Cu_1 do), or not. Now in 106*a*, R and Cu_1 lie upon high ridges, and all the veins are convex rods; hence it must be a *cast;* and, as the apex lies to the left, it must be a *left* wing. In No.120*a*, R and Cu_1 lie at the bottom of furrows, and all the veins are concave grooves; hence it must be a *mould;* and, as the apex lies to the left, it must have been formed by a *right* wing turned over, so that its underside lay uppermost.

Further, the fore- and hindwings of all Panorpids, though closely similar, differ in the following points:

(1) Sc always extends further towards the apex in the forewing than in the hindwing.

(2) In the hindwing, M tends to become fused basally with Cu_1, but this tendency is not so much in evidence in the forewing.

(3) In the forewing, Cu_1 ends up on the posterior margin of the wing somewhat beyond half-way. In the hindwing, it reaches only about half-way, or less.

Now, if we compare Nos.106*a* and 120*a*, we see at once that Sc ends up much further from the apex in 106*a* than it does in 120*a*. Further, although only a small remnant of Cu_1 is left in No.120*a*, yet the slant of this vein to the wing-axis is measurably less than in 106*a*. The measurements, carefully determined, give an angle of 23° for No.120*a*, 31° for No.106*a*. Measurements made to determine the obliquity of *corresponding portions* of Cu_1 in *Panorpa confusa* give 22° for the forewing,

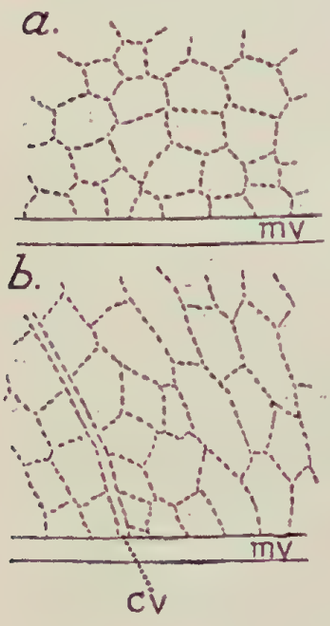
33° for the hindwing. Hence we must conclude, from the combined evidence of both Sc and Cu_1, that No.106*a* represents a *hindwing*, No.120*a* a *forewing*.

Unfortunately, not quite enough of the main stem of M^c is preserved to enable us to say definitely with what vein it tends to fuse basally. But, as the condition stated above in (2) is universally present in Panorpid wings (even in the archaic *Merope*, which has been claimed, with good reason, to be a Palæozoic remnant), there is no reason to suppose that the same rule did not hold for our fossil wings. Thus, in the restoration of these wings given in Plate ix., I have correlated character (2) with (1) and (3), so that fore- and hindwings are to be distinguished by three differences, as in recent Mecoptera.

The Structure and Hairiness of the Wing-membrane.—In the figures given of the two wings (Plate viii., figs.4, 5), and in their restoration (Plate ix.), I have purposely omitted the finer structure of the wing-membrane, which requires to be studied under a higher power. The structure is not everywhere equally well preserved in all parts of the wing; but a careful search soon reveals a number of places at which, by careful use of oblique light, the remarkable formation of the wing-membrane can be well studied and interpreted. Such a place is figured in Plate ix., fig.6, where I have drawn the structures seen upon and above one of the smaller main veins. These may be described as follows:—

(1) *Hairs upan the veins.*—Following up any vein under a moderate power, there will be found, at fairly regular intervals, the typical circular-based tubercles which indicate the bases of insertion of original *stiff hairs* or *bristles* upon the veins. A comparison with a cleared and mounted wing of *Myrmeleon* shows that these tubercles in *Archipanorpa* closely resemble those of *Myrmeleon* in size and position; if anything, those of *Archipanorpa* are the larger in proportion to the size of the veins, and of the wing as a whole. Thus we see that *Archipanorpa* had *hairy veins*, as in the Planipennia. Recent Mecoptera also possess these hairs, but they are not usually so large as in Planipennia, and they are generally more abundant and closely set.

(2) *Polygonal meshwork of the wing-membrane* —Turning from the vein to the membrane alongside it, we notice at once that this is not smooth, but is thrown into innumerable pits and ridges, with tubercles appearing upon the latter in many places. In places where this structure is well-preserved, it will be seen that the ridges form an *irregular polygonal meshwork*, enclosing sunken areas or *cellules* (shaded in Plate viii., fig.6). The large tubercles, which resemble those of the veins, are seated principally upon the swollen junctions of the ridges. The ridges are not as well-defined as actual veinlets would be, except here and there (Text-fig.6*b*, *cv*), where a particularly strong and straight ridge may be seen running out for some distance from a main vein. Nor are their tubercles usually as well-defined as are those of the main veins.



Text.fig.6-*

The area shown diagrammatically in Plate viii., fig.6, was selected from near one of the main veins on the basal portion of the preserved part of the wing. It is a typical unspecialised meshwork. But, in most parts of the wing, and especially towards the distal end, the polygons of the meshwork tend to become stretched out transversely, and somewhat obliquely to the main veins. This is represented diagrammatically in Text-fig.6*b*, whereas Text-fig.6*a* corresponds with the unspecialised portion shown in Plate viii., fig.6.

The only conclusion that I can come to, from a study of these peculiar structures, is that the ridges represent *the original Palæodictyopterous meshwork of veinlets in a degenerating stage*. The

* Diagrams of the Palæodictyopterous meshwork upon the membrane of the wing of *Archipanorpa magnifica*, n.g. et sp.,—*a*, from near base of preserved portion of wing (corresponding with Plate viii., fig.6); *b*, from distal portion of wing, showing tendency of the mesh to become stretched transversely and somewhat obliquely across the wing, (×20); *cv*, a strong cross-vein, not yet obliterated; *mv*, main vein, with macrotrichia omitted. The figure is intended to show only the *position*, and not the *structure* of the meshwork.

most probable cause of degeneration would be the using-up of the veinlet-chitin in the formation of the accumulated masses or tubercles in which the hairs are inserted. Thus *Archipanorpa* would illustrate an intermediate stage in the evolution of a *wing with a hairy membrane* from an *ancient net-veined* or *Palæodictyopterous* wing-type, and would give us the clues both as to the method whereby an open-veined wing, such as that of the Lepidoptera or Diptera, has been evolved from a closely-veined type, and also as to the method whereby the hairs (or, later on, the scales) become seated upon the membrane as well as upon the main veins.

(3) *Hairs upon the wing-membrane.*—In those places where the structure of the tubercles of the wing-membrane can be most clearly made out, they are seen to be very closely similar to those upon the wing-veins, both in size and form. We can distinguish an outer raised rim (indicated by the outer circles in Plate viii., fig. 6), and an inner depression or hollow (indicated by the inner circles in the same figure). There can be no doubt that these structures represent the tubercular bases of insertion of stiff bristle-like hairs; for the insertions of such hairs in the wings of recent Planipennia are exactly similar to them. I propose to call these hairs *macrotrichia*.

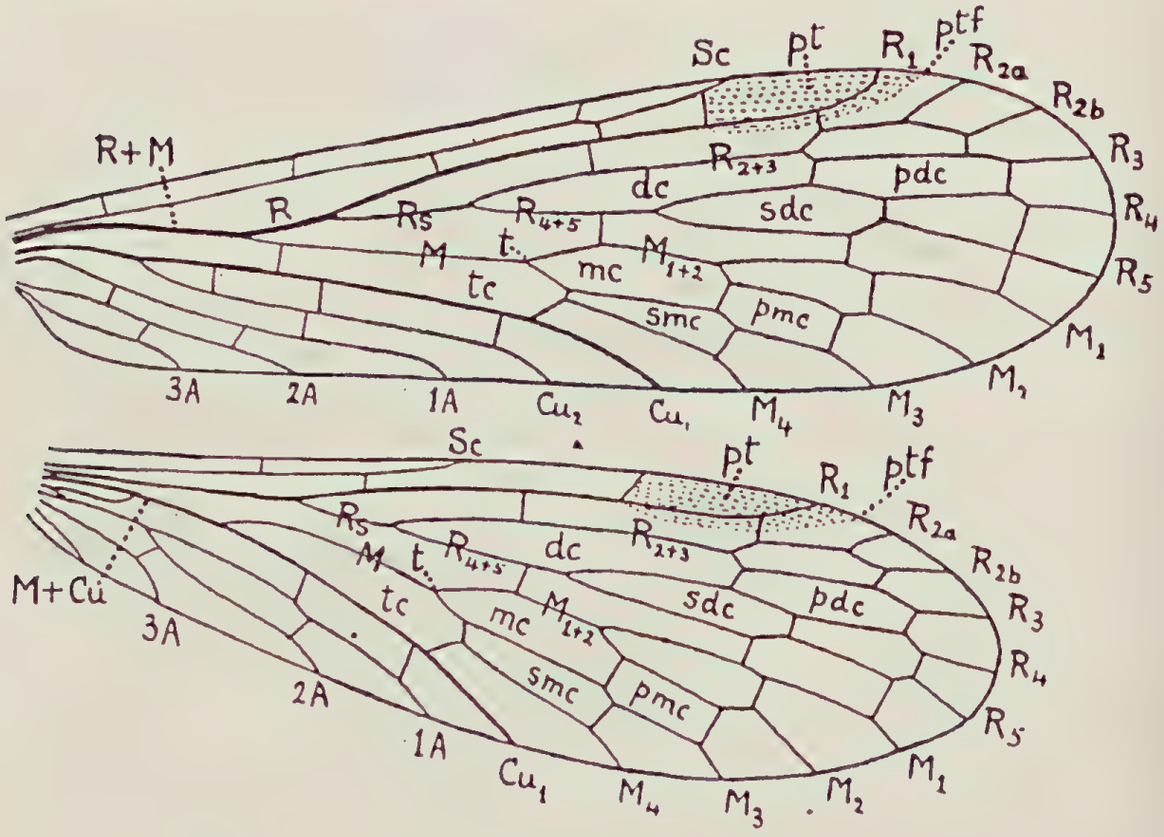
Besides these tubercles, a careful examination of the wing-membrane shows that it is covered all over with minute pits, mere depressions without any visible raised rim, and of a size so small as to be rather easily confused with the grain of the rock on which the fossil is impressed. These, I consider, represent the insertions of minute hairs, several times smaller, and far more numerous, than the macrotrichia. These hairs may be termed *microtrichia*. In most parts of the wing, they run in closely-set parallel lines, passing alike over ridge and hollow.

The structure of the pterostigma differs from that of the rest of the wing-membrane only in lacking the polygonal ridges, and in being of a single thickness throughout. This makes it appear very smooth in comparison with the rest of the wing. On examination under a moderate power, both macrotrichia and microtrichia can be seen to be present upon it.

The polygonal meshwork of ridges is absent from all recent Mecoptera. Microtrichia, however, are abundant all over the wing-membrane, though excessively minute in some genera (e.g., *Panorpodes*). Macrotrichia are present only towards the distal end of the wing, especially in the pterostigmatic region. In the polygonal cells formed between Rs and Cu_1, there may be seen, in certain genera (e.g., *Panorpa*), two or three irregular rows of macrotrichia.

In the figures given in Plates viii.-ix., I have purposely shaded-in the pterostigma, in order to distinguish it from the rest of the wing-membrane. In the actual fossils, it is not darkened in colour.

Type, forewing, Specimen No.120*a*; hindwing, Specimen No.106*a* (Coll. Queensland Geol. Survey).



Text-fig.7.

Wings of *Panorpa confusa* Westwood, with colour-pattern omitted, to show venational scheme, (×9). For lettering, see p.200.

Corrigenda: for M_4 *read* M_4+Cu_{1a}, *and for* Cu_1 *read* Cu_{1b}.

In Text-fig.7, I have drawn the wings of *Panorpa confusa* Westwood, (omitting colour-pattern), for comparison with those

of *Archipanorpa magnifica*. The pterostigma is shaded in, as in the figures of *Archipanorpa*. A comparison of the two forms enables us at once to fix the limits of the main veins in *Archipanorpa*, and to name the principal cells of the wing. The steps of the determination may be briefly outlined as follows :—

(1) The radius (R) is a strongly-built, highly convex vein running *through* the pterostigma (*pt*). Therefore I searched first of all for the pterostigma, which was easily located, both from its smoothness compared with the rest of the wing-membrane, and because of the *pterostigmatic furrow (ptf)* bordering it posteriorly. Having found it, the radius was at once determined. There were then *two* other veins ending up on the anterior wing-border between the radius and the base of the wing; whereas, in *Panorpa*, as in all recent insects, there is only *one* (the subcosta, Sc). It became clear, therefore, that *Archipanorpa* possessed not only a subcostal vein, Sc, but also an archaic costal vein, C, separated from the costal or anterior border, as in some of the larger Carboniferous fossils (e.g., the *Meganeuridæ* of the Order Protodonata).

(2) Turning next to the area of the wing below R, in specimen No.106*a* (hindwing), the cubitus, Cu_1, is easily determined as a strongly convex, obliquely-running vein, ending about half-way along the posterior border. Between this and R, basally, there lie two main stems, of which the upper must be the radial sector, Rs, (its point of union with R is not preserved in the fossil), and the lower must be the media, M.

(3) The first forking of Rs is preserved in the fossil. Here Rs divides into R_{2+3} above, and R_{4+5} below. The cell enclosed between these two veins basally is the *discoidal cell* (*dc*). R_{2+3} again forks into R_2 and R_3, R_{4+5} into R_4 and R_5, and both are sessile upon *dc*, as in the two Trichopterous wings already dealt with. The area enclosed between R_2 and R_3 would be, in Trichoptera, the *first apical fork* (Af.1 in Text-figs.2-4). But, in most Mecoptera, R_2 forks again into R_{2a} and R_{2b} (Text-fig.7). This occurs in *Archipanorpa*; but, above and beyond this, R_{2b} forks a second time into R_{2b} and $R_{2b'}$. Moreover, R_3, which remains unforked in both Trichoptera and Mecoptera, in *Archi-*

panorpa divides into R_{3a} and R_{3b}, and each of these again divides* before reaching the wing-border.

(4) The area enclosed between R_4 and R_5 would be, in Trichoptera, the *second apical fork* (Af.2 in Text-figs.2-4). In Mecoptera, this area is often subdivided by a cross-vein (Text-fig.6). In *Archipanorpa*, both R_4 and R_5 divide into two again before reaching the wing-border. Thus Rs, which in Trichoptera sends *four* veins to the apical wing-border, and in Mecoptera *five*, sends no less than *nine* such veins to the border in the hindwing of *Archipanorpa*, *eight* in the forewing.

(5) Turning next to the media (M), we see that the *thyridium* (*t*), or *median fork*, is clearly preserved in both wings, lying just below the first forking of Rs. As this is its position also in the two Trichopterous wings already dealt with, we are probably right in assuming that it is the archaic condition, and that a shifting of the thyridium to a level distad from the level of the first forking of the radius (as in *Panorpa*, Text-fig.7; and in many recent Caddis-flies) is a cænogenetic character. The cell below *t* is the *thyridial cell* (*tc*), and is only partially preserved in both wings. At *t*, M forks into M_{1+2} above and M_{3+4} below, and the two branches enclose between them the *median cell* (*mc*). M_{1+2} then divides into M_1 and M_2, and M_{3+4} into M_3 and M_4; and the forks thus made are sessile upon *mc*, as in the two fossil Trichopterous wings already studied, and in recent Mecoptera (Text-fig.7).

(6) The area enclosed between M_1 and M_2 would be, in all Trichoptera and true Mecoptera, the *third apical fork* (Af.3, in Text-figs.2-4). In *Archipanorpa*, both M_1 and M_2 fork again; in the hindwing, the two middle branches fuse together, so that only *three* separate veins reach the wing-border, instead of *four* as in the forewing. This difference offsets the difference in the behaviour of R_3 in the two wings (see above), and makes the total number of apical end-veins the same in both wings (viz., seventeen between R and Cu_1).

(7) The area enclosed between M_3 and M_4 would be, in all Trichoptera and true Mecoptera, the *fourth apical fork* (Af.4 in Text-figs.2-4). The archaic condition of this fork is that it is

* In the hindwing; in the forewing, only the lower fork divides.

very strongly sessile upon *mc*; in other words, M_{3+4} again divides before it has passed far from *t* round the border of *mc*. M_3 continues on as the lower border of *mc*, and passes on to the wing-border without branching, in *Archipanorpa* as in all Trichoptera and Mecoptera. M_4, in *Archipanorpa* and all Mecoptera, behaves differently from what it does in most Trichoptera (see, however, the formation in Text-fig.3). Diverging strongly from M_3, *it picks up a branch* Cu_{1a} *thrown out anteriorly from* Cu_1. In Mecoptera (Text-fig.7), the two fuse and continue on to the wing-border as $M_4 + Cu_{1a}$. In *Archipanorpa*, they only fuse for a short distance, and then run separately to the wing-border.

(8) Thus far, the structure of the wing is clear. Below and basad from Cu_1, not enough is preserved for us to be sure of the structure of the anal area. In all recent Mecoptera, Cu_2 is present in the forewing (arising from Cu_1 very close to the wing-base), but absent in the hindwing. It would appear that the original Cu is completely altered in the hindwing, Cu_1 having become fused with M, and Cu_2 with 1A. The remnants of the base of Cu_1 are to be seen as a short, weak, waved vein running in a curve from the base to join M a short distance beyond the base (Text-fig.7). Bearing in mind the archaic structure of *Archipanorpa*, the presence of many longitudinal veins, and especially the presence of the costal vein C in both wings, I think the probabilities are all in favour of a normal Cu_2 being present in the hindwing of *Archipanorpa*. I have, therefore, restored the wing on that supposition. The suggested anal area calls for no comment. The complete restoration of both wings is given in Plate ix.

With regard to the question of the wing-coupling apparatus, it has generally been assumed that the Mecoptera are descended from forms in which the wings were free and unconnected in flight. But, in a new family of the Order which I have recently discovered in Tasmania, I was surprised to find a well-developed wing-coupling apparatus present, consisting of jugal lobe on the forewing, and jugal process with frenulum on the hindwing. As in the Planipennia and in the females of most moths, the frenulum consists of two strong bristles directed obliquely outwards. Following up this discovery, I examined other genera of

Panorpids, and discovered that the frenulum is present in all forms examined by me, though only vestigial in the highly specialised *Bittacidæ*. Hence it is clear that the ancestors of the Mecoptera must have possessed the wing-coupling apparatus in a well-developed form; so that its inclusion in the restoration of the wing of *Archipanorpa* (Plate ix.; *jl*, jugal lobe; *jp*, jugal process; *fr*, frenulum) needs no further apology or explanation.

WING-NOTATION USED IN PLATES AND TEXT-FIGURES.

1A, first anal vein—2A, second anal vein, or axillary vein—3A, third anal vein, or basilar vein—4A, fourth anal vein (rarely present)—Af_1, Af_2, Af_3, Af_4, Af_5, the five apical forks, or end-forks, formed between the final bifurcations of the main veins—C, costal vein—cs, costal space—Cu, cubitus—Cu_1, Cu_2, its primary branches—Cu_{1a}, upper branch of Cu_1 in Mecoptera; Cu_{1b}, continuation of Cu_1—*cuf*, cubital fork—*dc*, discoidal cell—*fr*, frenulum—*jl*, jugal lobe—*jp*, jugal process—M, media—M_1, M_2, M_3, M_4, its four main branches. (Further branchings are denoted by Cu_{1a} suffixes *a* and *b*).—*mc*, median cell—*pcs*, precostal space (in Protomecoptera) —*pdc*, post-discoidal cell—*pmc*, postmedian cell—*pt*, pterostigma—*ptc*, post-thyridial cell—*ptf*, pterostigmatic furrow—R, radius; R_1, its main stem—*rf*, radial fork—Rs, radial sector; R_2, R_3, R_4, R_5, its four main branches. (Further branchings are denoted by suffixes *a* and *b*, and branchings of these by *a*, *a'*, or *b*, *b'*).—S_1-S_{12}, branches of Rs in Planipennia—Sc, subcosta—*scs*, subcostal space—*sdc*, subdiscoidal cell—*smc*, submedian cell—*t*, thyridium (=median fork) —*tc*, thyridial cell.

EXPLANATION OF PLATES VII.-IX.

Plate vii. (Trichoptera).

Fig. 1.—*Mesopsyche triareolata*, n.g. et sp. Forewing; (×7·5).

Fig. 2.—*Triassopsyche dunstani*, n.g. et sp. Forewing; (×7·5).

Plate viii. (Planipennia and Protomecoptera).

Fig. 3.—*Protopsychopsis venosa*, n.g. et sp. Portion of wing; (×5).

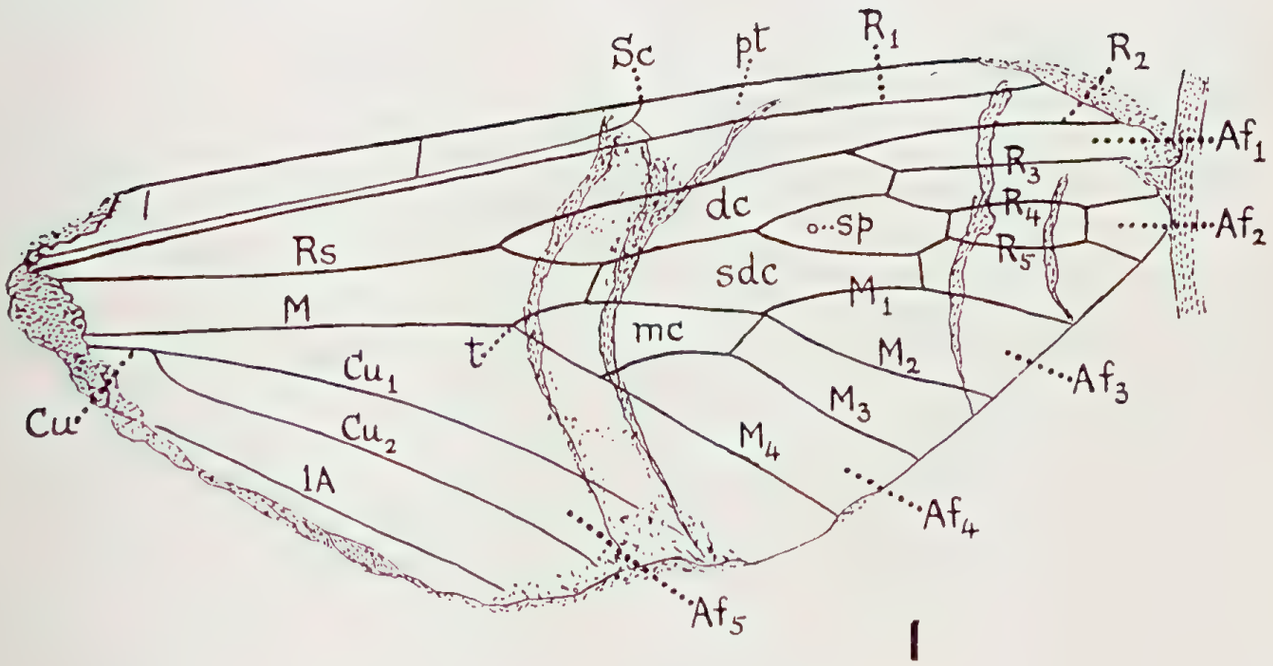
Fig. 4.—*Archipanorpa magnifica*, n.g. et sp. Forewing; (×5).

Fig. 5.—*Archipanorpa magnifica*, n.g. et sp. Hindwing; (×5).

Fig. 6.—*Archipanorpa magnifica*, n.g. et sp. A small portion of the hind-wing, showing part of a main vein carrying the basal tubercles of three macrotrichia, and the membrane above it, with its polygonal meshwork (the ridges left unshaded), basal tubercles of eleven macrotrichia (double concentric circles), and small pits for insertions of microtrichia (in black). Semi-diagrammatic; (×73).

Plate iv.

Restoration of fore- and hindwings of *Archipanorpa magnifica*, n.g. et sp.; (×4·5).



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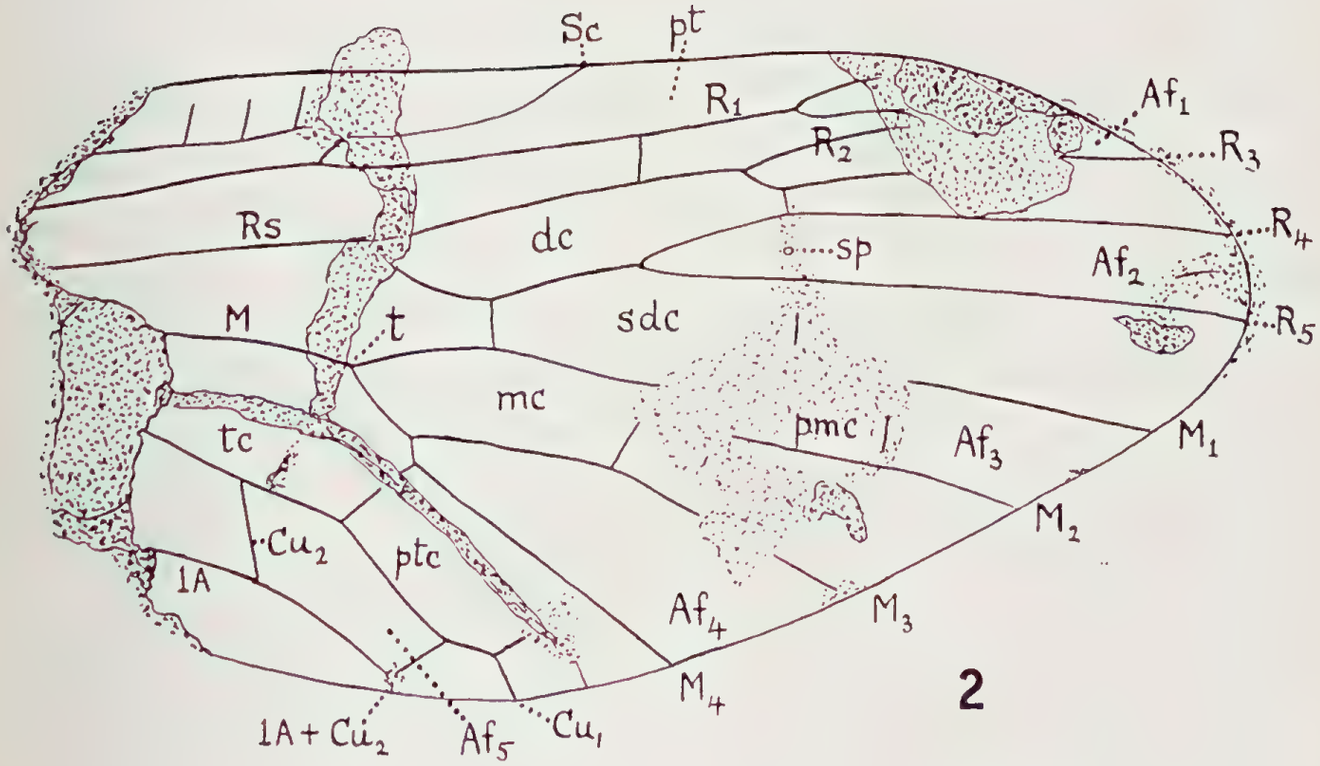

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R. J. T. del

Fossil Trichoptera.

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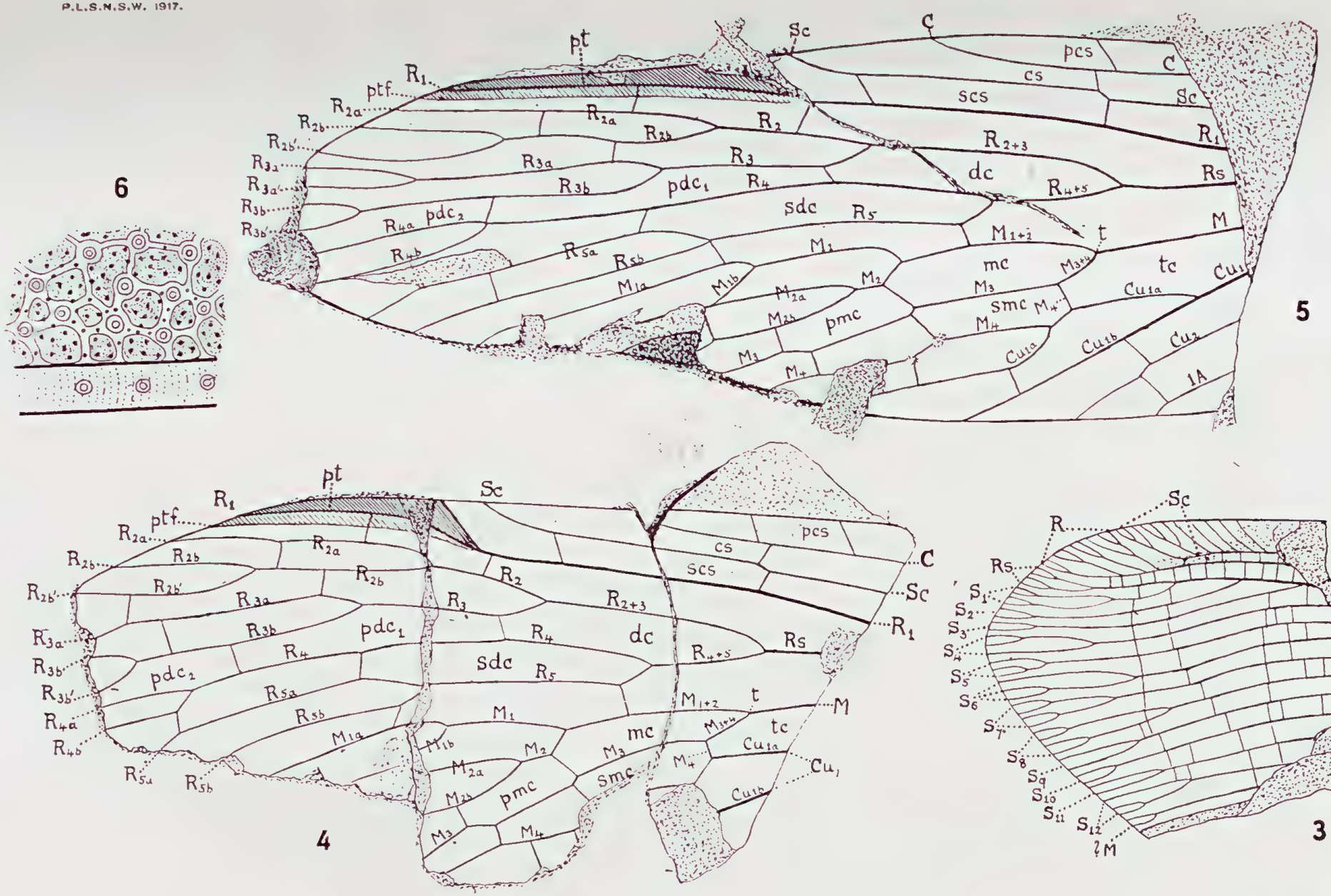

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Fig. 3. Fossil Planipennia.

Figs. 4-6. Fossil Protomecoptera.

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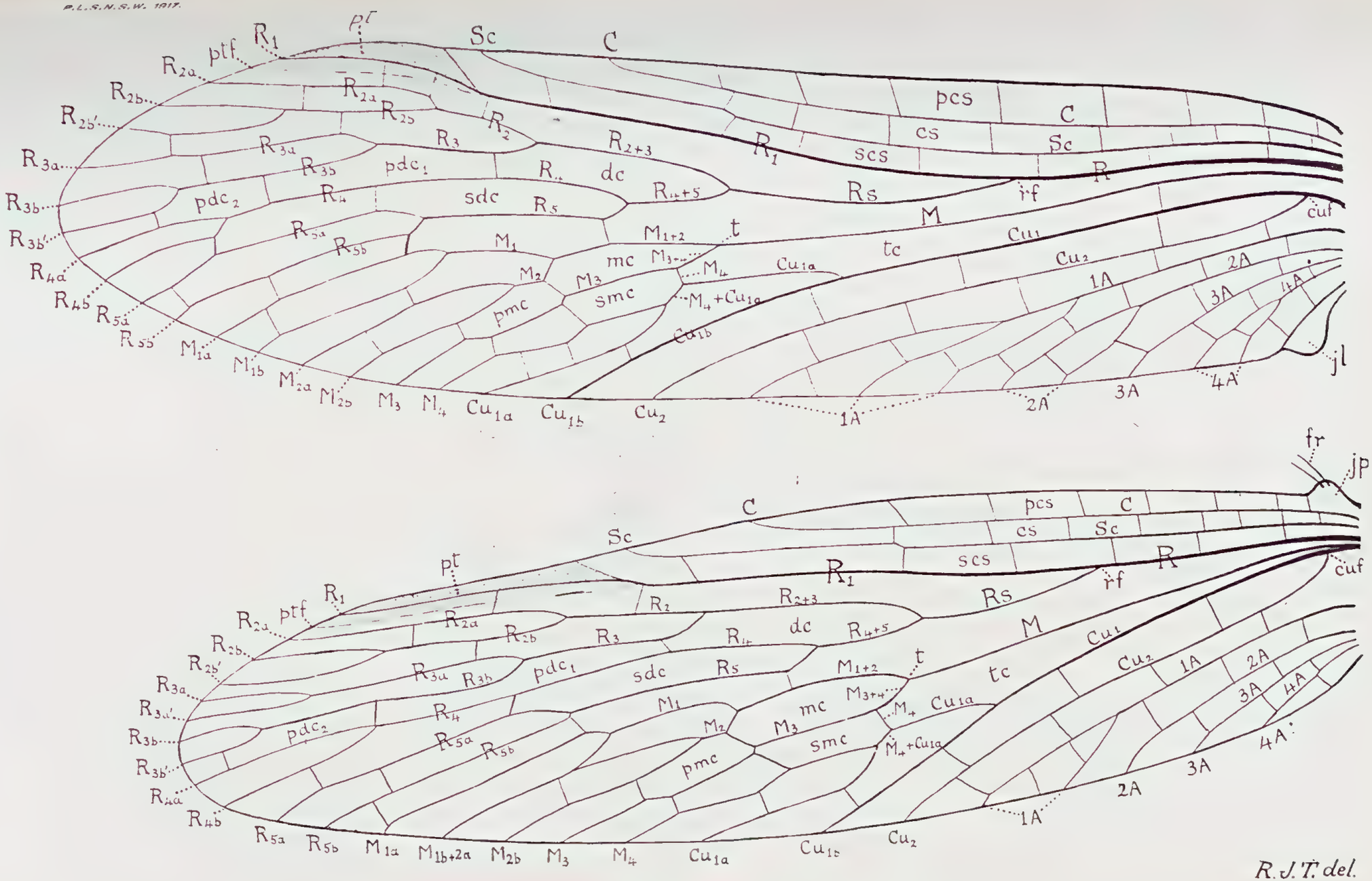

Restoration of wings of *Archipanorpa magnifica* (Protomecoptera).

VICTORIA.

[*From the Proceedings of the Linnean Society of New South Wales, 1917, Vol. xlii., Part 3, November 28th.*]

MESOZOIC INSECTS OF QUEENSLAND.

No. 2. The Fossil Dragonfly *Æschnidiopsis* (*Æschna*) *flindersiensis* Woodward), from the Rolling Downs (Cretaceous) Series.

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(Plates xlii.-xliii.)

The very interesting, fossil Dragonfly-wing, that forms the subject of this paper, was found associated with the small bivalve Mollusc, *Aucella hughendensis* Eth., in the chocolate-coloured limestone of the Flinders River, North Queensland,* seven miles above Marathon Station This limestone is of Cretaceous age. The fossil was sent to Dr. Henry Woodward, F.R.S., etc., and was described by him(5) in 1884 as *Æschna flindersiensis*, "as recognising its locality on the Flinders River, and one of Australia's earliest explorers and heroes."

That the wing did not belong to the recent genus *Æschna*, nor to any recent subfamily, was obvious enough from Woodward's own figure. In 1908, Handlirsch, who had never seen the fossil itself, removed it to the extinct family *Æschnidiidæ*(2), and placed it in the genus *Æschnidium*.

Wishing to study this insect, I wrote some years ago to the Director of the Queensland Museum, to try and find its whereabouts. He soon satisfied me that it was not in the Museum Collection. Inquiries from Mr. Dunstan, Chief Government Geologist of Queensland, at the Geological Survey, elicited the

* The locality is not far from the town of Hughenden, and is now classed as Western Queensland; it lies almost exactly half-way along a North-South line drawn from Cape York to the New South Wales border.

fact that nothing was known of it there. I wrote, therefore, to the British Museum authorities for information, and was informed that the fossil had undoubtedly been returned by Dr. Woodward to the Queensland Geological Survey Collection; where it was ultimately found, without a label, in an accumulation of odd specimens.

The rock-specimen, on which a number of fragments of *Aucella* are plainly visible, is hard, dark greyish-brown, and moderately finely grained. The dragonfly-wing lies upon a fairly even plane of fracture, and has its apical third, or a little more, and also a small piece of the broad anal area at the base, cut off by two parallel fractures of the rock running obliquely across the wing. Unfortunately, a further irregularity in the fracture-plane has extended up from the posterior margin near the base, well into the middle of the wing, and has thus removed a considerable amount of the interesting area lying below the triangle, as can be seen in the photographs on Plate xlii.

The description and figure given by Dr. Woodward, in 1884, may be described as broadly accurate, as far as the requirements of the day were supposed to go, with the exception of a few misstatements which should have been avoided, even by one who claimed no special knowledge of Dragonfly Wing-Venation. For instance, in describing the main veins or "nervures" of the anterior border of the wing, we are told that the "costal nervure," the "sub-costal," and the "median" (in modern terminology, C, Sc, and R) "pass along the anterior border until they reach the '*node*,' or cubital point"; after passing which, only the two anterior ones "are continuous to the extremity of the wing, and support the pterostigma." Now this is not true of any Dragonfly, for it is, in every case, the *first* and *third* of these veins (C and R) that run past the nodus and support the pterostigma. Further, in the fossil under discussion, it is less than ever true, for it is easily seen that, in this case, *all three* of these veins appear to pass the nodus, and Woodward's own figure shows them so doing. Again, it is somewhat puzzling to be told, on p.338, that the fossil is "perhaps referable to the subfamily

Gomphinæ," and to have it placed, on p.339, in the genus *Æschna*; since, long before 1884, the two subfamilies *Æschninæ* and *Gomphinæ* had been clearly recognised and distinguished.

However, Woodward got very close to the mark, as regards the true relationships of this fossil wing, when he noticed its close resemblance to a fossil wing found in the Lower Purbecks of Durdlestone Bay, Dorset, England, and figured by Prof. J. O. Westwood (4) in 1854. Though Woodward does not mention the name of this specimen, there can be little doubt that he referred to *Æschnidium bubas* Westwood, a form so similar to the more complete *Æschnidium densum* Hagen, that Handlirsch thinks that the two may very well be specifically the same.

Woodward's figure (5, Pl. xi., fig. 1) shows a wing undoubtedly belonging to the *Æschnidiidæ* in its general features, but apparently differing from the type-genus, *Æschnidium*, in some important points, notably in the extraordinary, transversely narrowed triangle, the incomplete arculus, and the weakly-formed nodus. These points are so important that, if the fossil really agrees with Woodward's figure, it would be impossible to endorse Handlirsch's removal of it to the genus *Æschnidium*. It would be necessary to propose a new genus for its reception. Hence, in making a careful study of the wing, I have paid special attention to these three important areas, with the results that I now propose to give in this paper.

It is necessary to state, first of all, what is the degree of preservation of the fossil wing, and, in particular, of the small veinlets and areolets that cover it so abundantly. The rock on which the wing is impressed is very hard. The outlines of the main veins, and their concavity or convexity, are preserved to perfection. On the other hand, the finer veinlets and areolets are not thus perfectly preserved, yet they can be seen to be present in all parts of the wing. It may be stated that every polygonal areolet is preserved in such a way that its *interior* is indicated on the rock as a small depression, while the veins, that form its periphery, are not usually clearly marked (except only in the case of cross-veins passing direct from one main vein to

another); so that, if one attempts to draw the outline of a cell under the camera lucida, its exact shape and position depend partly upon the direction of light. In order to show up these areolets, it is necessary to use very oblique light. Consequently, if the light be directed from the right side of the areolet, the dividing lines between light and shade (which are the lines that give us the rough outline of the cell) will lie too far to the right; while, with light directed from the left, they will lie too far to the left. That this is so, I easily proved by drawing a typical areolet or two, with two or more different lightings, when the outlines of the cells did not wholly coincide. Therefore, in all important cases, it was essential to make at least two drawings, and to gauge the true outline of the cell as a middle position between them. By this somewhat laborious method, I hope that I have succeeded in obtaining a more accurate result of the details of this wing than would otherwise have been possible.

The general appearance of the fossil is seen from the two photographs in Plate xlii. In Fig. 9,* the light was directed on to the fossil from the left, or basal side, at an angle of about 20° to the plane of the wing. In fig. 10, the light was similarly directed from the right or distal side. A comparison of the two figures shows the strong convexity and concavity of the veins very clearly. The following are the convex veins:—C (very slightly), R + M to arculus, R beyond arculus, Ms, M_4, A and all its descending branches, and the distal side of the triangle.

The following are the concave veins:—Sc, its apparent continuation beyond the nodus, the nodus itself, the subnodus and its continuation Rs; M_1, M_2, M_3, Rspl, Mspl, Cu, and the anterior and proximal sides of the triangle.

It will be seen from this, that the plane of the triangle is not horizontal, but inclined upwards distally, so that this area

* The numbers of the figures and text-figures in this series of papers are made concurrent from one paper to another. In No. 1, the figures in Pl. ix. were inadvertently left unnumbered; the forewing of *Archipanorpa magnifica* should have been fig. 7, the hindwing fig. 8. Fig. 9 of Pl. xlii. in this paper follows on consecutively.

catches the light directed from the base (Plate xlii., fig.9) but lies in deep shade when the light is directed from the distal side.

It should also be noticed that the numerous convex branches of A are separated by concave supplements. None of these are true branches of A, for it can easily be seen that they are all incompletely formed as they approach A from below. Woodward's figure shows this fairly well, but an examination of the actual fossil (Plate xlii., fig.10) shows, along the broken-off edge below and proximad from the triangle, how very marked this alternate convexity and concavity really is.

The *costa* (C) is much thickened at the base, for a distance of about 2 mm.; there are only very faint indications of the typical "ribbing" of this vein. For most of its length, it appears to be a rather weak vein, very little stronger than Sc. Between C and Sc, a parallel supplement (Cspl) is developed, beginning weakly just above the arculus, and continuing more strongly right to the nodus. This is not shown at all in Woodward's figure. The cross-veins between C and R are mostly weak and irregularly placed; but two complete ones can be made out, which are shown slightly thickened in Plate xliii., fig.11. These probably represent the two hypertrophied antenodals of recent *Æschnidæ*. Beyond the nodus, there is only a much fainter indication of a corresponding supplement, though Woodward figures this as if it were quite obvious.

The *subcosta* (Sc) is very plainly marked, lying in a moderate furrow from base to nodus. At that point, it *appears* to divide into three, one branch turning sharply upwards to join the costa, a second running straight on through the nodus, parallel to and between C and R, and a third turning obliquely downwards to meet R at the subnodus. The actual structure of these three veins will be fully discussed when we come to deal with the nodus itself.

The *radius* (R) and *media* (M) appear to be very slightly separated at the extreme base of the wing, but fuse together almost immediately, and continue to the arculus as a single, thick, convex vein, R + M. Thence onward, R runs almost

straight—actually with a very slight double-curving—below and parallel to C and Sc. The question of the formation of the *radial sector* (Rs) must be dealt with under the discussion of the nodus.

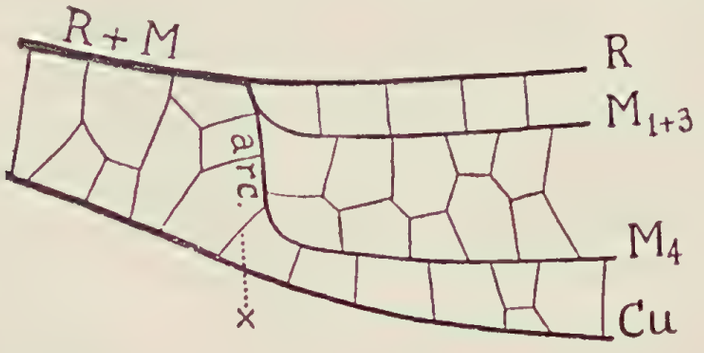
The *media* (M) divides at the arculus into the concave and weak M_{1+3}, and the stronger, convex vein, M_4. At a point a little beyond the distal end of the triangle, M_{1+3} divides into M_{1+2} above, and M_3 below, both weakly formed and concave. Immediately afterwards, M_{1+2} gives off, posteriorly, a strong concave vein, corresponding with the *bridge-vein* of recent Anisoptera. This vein, for the reasons given below in my discussion of the nodus, I have definitely decided to call the *Zygopterid sector* (Ms). It runs parallel to, and a little below, M_2. M_{1+2} divides into M_1 and M_2, just before these two veins are crossed by the vein descending from the subnodus, as Woodward's figure accurately shows. Below Ms, there is a slight indication of the formation of a *radial supplement* (Rspl). M_4 runs from the arculus to the upper distal angle of the triangle, and, from there on, curves gently downwards, beneath and subparallel to Ms, to reach the posterior wing-border far beyond the level of the nodus. Beneath M_4, a very long, *median supplement* (Mspl) is developed, lying slightly concave to M_4, but not linked up with the triangle (as would appear from Woodward's figure).

The *cubitus* (Cu) is a fairly strong, concave vein, running, with a very slight double-curving, below the arculus, to join the triangle at its proximal angle. There it turns sharply downwards, at right angles to its previous course, forming the proximal side of the triangle itself. Its further course is unfortunately lost, owing to the fracture below the triangle, already mentioned. But, at the distal side of this fracture, it is easy to pick up again a strongly concave vein descending to the wing-border almost directly under the nodus. This must certainly be Cu_1; but where Cu_2 is, or whether it is present at all, is not so easy to determine.

The *analis* (A) is a very strongly-marked, convex vein, running in a gentle curve (concave to the costa) from the base to the proximal angle of the triangle, where it meets Cu. I can find

no absolutely satisfactory evidence of the existence of an *anal crossing*; but the oblique vein descending from Cu just below the arculus, to meet A at the point where A_3 descends from it, may possibly represent this vein. If we reckon the distal portion of A, which links up with Cu, and forms the upper side of the large subtriangle, to be a secondary formation (as in recent Anisoptera), we can call the seven clearly-marked, convex, descending branches A_1, A_2, etc., to A_7. There may be one or two more similar branches in the narrow anal portion of the base, that is missing in the fossil.

We can now proceed to discuss the three most important areas of the fossil wing, viz., the *arculus*, the *triangle*, and the *nodus*.



Text-fig.8.
Æschnidiopsis flindersiensis (Woodward), hindwing; region of arculus; (× 12½).

The *Arculus* (Text-fig.8).

This area is very beautifully preserved, so that a little care in arranging the lighting allows us to draw every cross-vein in its exact position. The arculus itself exhibits two very primitive features to perfection:—

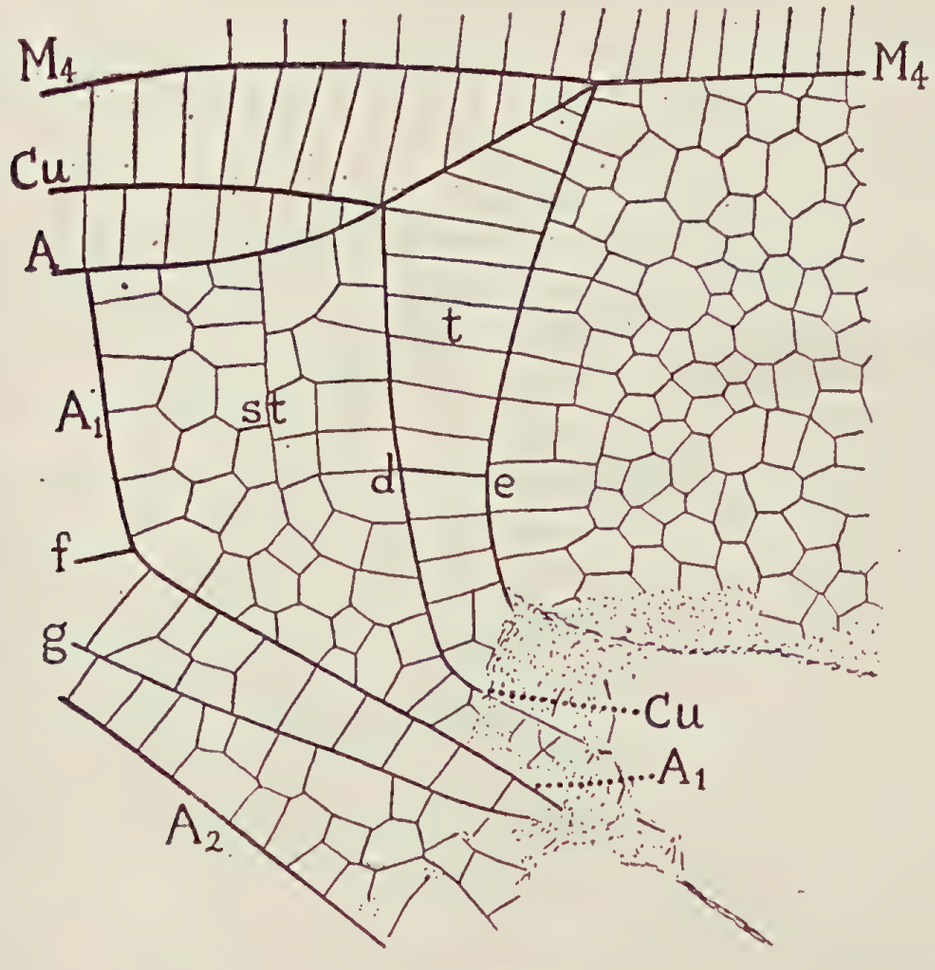
(*a*) It is incomplete posteriorly, the cross-vein (*x*) destined to complete it having not yet fully taken up its position.

(*b*) The upper sector of the arculus (M_{1+3}) leaves the main stem of M very close under R, as in the recent *Thorinæ*.

As a contrast to this, the actual angle made by M_4 with R is greater than that seen in many recent Dragonflies, being very nearly a right-angle. Woodward's figure makes this angle much

too small, and is also inaccurate in showing the two sectors of the arculus as if they came off separately from R.

If Handlirsch's figure of *Æschnidium densum* Hagen, is correct, that dragonfly had a much more specialised form of arculus; so that the differences between it, and the species under discussion, would alone be sufficient to admit of placing the latter in a new genus.



Text-fig.9.
Æschnidiopsis flindersiensis (Woodward), hindwing; region of triangle; (× 12½).

The *Triangle* (Text-fig.9).

The anterior portion of the triangle and its broad supporting subtriangle are very well preserved. Unfortunately, as we follow these structures posteriad, their formation becomes less easy to make out; and, finally, just at the extreme posterior end

of the triangular region, the fracture already mentioned cuts us off from completing our survey. Woodward, in his figure, traces the veins, called by me A_1 and A_2, across this fracture, together with two interpolated supplements. This is quite unjustifiable, particularly as he makes both these veins, which, before crossing the fracture, are strongly convex, pass, on reaching the other side, into veins which are *quite as strongly concave*, and which, therefore, if they are parts of the main veins at all, and not mere supplements, must belong to Cu. The only ridgings that can be seen running across the area of bare rock forming the fracture are shown by dotted lines in Plate xliii., fig.11. As these are continued far beyond the posterior border of the wing, and as similar, though not quite so plain, ridgings can be made out in the area beyond the costal margin of the wing, I can only conclude that they are part of the structure of the fracture, or of the grain of the rock, and have nothing whatever to do with the wing itself.

The *triangle* itself is certainly the most remarkable structure of the kind known in the hindwing of any Anisopterous Dragonfly, owing to its intense narrowing in a transverse plane. Its shape, taken in conjunction with its broad and somewhat quadrangular subtriangle, at once suggests a comparison with the same structures in the *forewings* of the most highly-developed recent *Libellulidæ*. The two formations are certainly parallel; but, as we cannot trace out the course of the cubitus and its branches with certainty in our fossil, it does not seem possible to institute a detailed comparison.

Text-fig.10 shows the actual shape of the triangle and subtriangle. In Woodward's figure, the shape of the triangle is not quite correctly indicated, and it is made to appear wider anteriorly than it really is. Further, the long, distal side is not so curved as in Woodward's figure; and the short, upper side is *absolutely straight*, with both Cu and A meeting it together at its extreme, proximal end. The cross-veins in the triangle itself are all simple and subparallel, and are more numerous than would appear from Woodward's figure. One of these cross-veins, the

seventh from the basal to the distal side, is very clearly visible in whatever direction the light may be arranged, and is evidently much thicker than the others. Further, it is very distinctly concave. It would seem, therefore, very likely that this vein is really part of Cu_1, so that the forking of the cubitus takes place at the posterior basal angle of the triangle (the point *d* in the figure). If this be so, then the continuation of the proximal side must be Cu_2; while Cu_1, after leaving *d*, crosses to meet the long distal side at the point *e*, where it turns sharply downwards to continue the line of that side posteriad. It must be noted, however, that this continuation remains highly convex. In all recent Anisoptera, Cu_1 remains concave throughout its length, whereas Cu_2 becomes convex after leaving the triangle. That the convex vein does not continue to the wing-border in our fossil, is quite evident, since, on the other side of the fracture, one finds a strongly concave vein running to the border, just in the usual position for Cu_1. We have, therefore, two alternatives: either (*a*) if the cubital fork is at *d*, then the local convexity of Cu_1 just below the triangle must be attributed to the influence of the strong distal side of the triangle dominating it for some distance, though it soon sinks into the usual concavity; or (*b*) the vein *de* may be only a strengthened cross-vein, and the distal side may continue below it to meet the proximal side at some point just within the obliterated area, so that the triangle is really triangular, and not quadrangular; if so, then the cubital fork is at this latter point, and the two branches of Cu may very well possess their usual characters from the very start. A study of Handlirsch's figure of this part of the hindwing of *Æschnidium densum* Hagen, (2, Atlas, Plate xlvii., fig. 16) fails to help us here, though it is quite likely that an examination of the actual fossil might give us the necessary clue. Thus the actual shape of the triangle, and the position of the cubital fork in our fossil, must remain doubtful. It is, indeed, just possible that the triangle may remain open posteriorly, as the subtriangle appears to do also in this remarkable wing-form.

The *subtriangle* is a wide, irregularly quadrangular area,

bounding the triangle proximally, and enclosed by a continuation of A above (this must be a specialised cross-vein, if the formation is the same as in recent Anisoptera), A_1 proximally, and the bent-down portion of Cu distally. Posteriorly, the area is narrowed by the converging of A_1 towards Cu; but whether they ever meet, so as to complete the closure of the subtriangle, there is unfortunately not quite enough of the wing preserved to show us. At the edge of the fracture, Cu appears definitely to have turned, so as to run closely parallel to and above A_1; so that the chances are that this area is not closed off posteriorly by any strong vein. Within the subtriangle, a number of small, irregular, polygonal areolets form a close meshwork, four cells wide in the broadest portion. Proximally, the subtriangle itself is supported by two struts, *f* and *g*, formed by alignment of the boundaries of numerous cellules. Of these, *f* passes from A_2 to A_1 almost at right angles, meeting the latter at its bend; while *g* is much longer and very oblique, meeting A_1 just on the edge of the fracture.

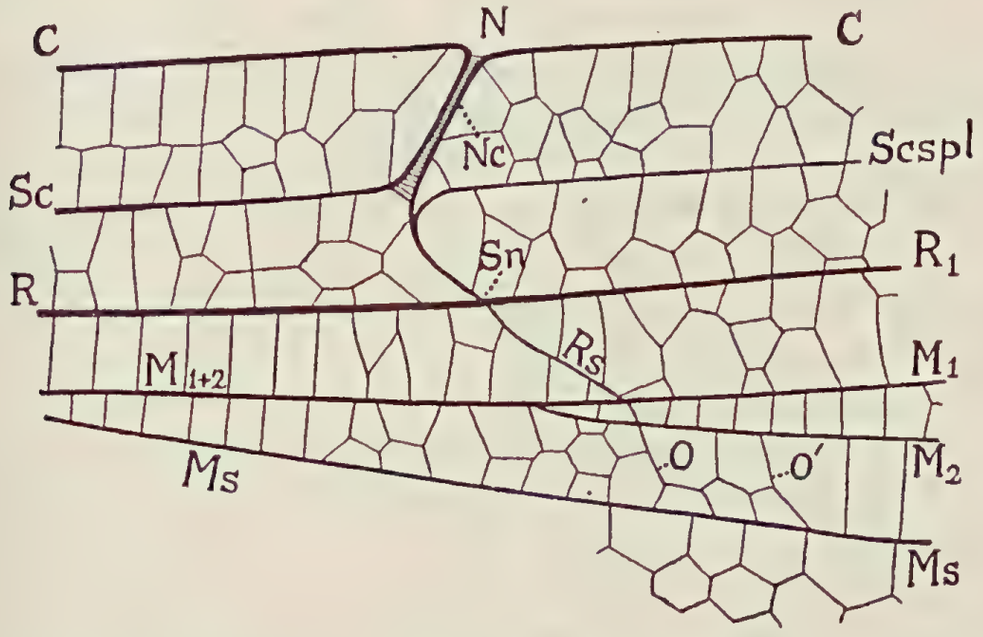
Distally from the triangle, there lies a broad area containing a very large number of small, irregular, unspecialised, polygonal cellules. As far as I can make these out, they are much more numerous than Woodward's figure would indicate; and I can find only the slightest traces of the supplements indicated by him as descending obliquely from the most proximal portion of Mspl; nor is that part of Mspl itself at all evident. Plate xliii., fig.11, shows more accurately the appearance of this area.

The *Nodus*.(Text-fig.10).

This area is very well preserved, on the whole; but, unfortunately, the nodus itself is a weak formation, so that its exact structure is not easy to determine. I have studied it under oblique light from several different directions. A correlation of the drawings obtained in this manner gives the result shown in Text-fig.10, which, I think, is as accurate as we can hope to get.

Approaching the nodus, the costal vein is not strongly formed, and shows practically no sign of "ribbing." At the nodus itself,

the break in the costa is not very strongly marked, but is evident from the sudden drop in level. Examination in certain lights shows the presence of *two* distinct veins, both weakly formed, bounding the nodal furrow, one on either side. Of these, the proximal is the upturned end of Sc, the distal is the *nodal cross-vein* (*Nc*). This latter is prolonged below Sc, for a short distance, before it receives the downwardly-arching end of the *subcostal supplement* (*Scspl*), or vein which appears to form a prolongation of Sc beyond the nodus. That there is a distinct gap



Text-fig. 10.

Æschnidiopsis flindersiensis (Woodward), hindwing; region of nodus and radial sector; (× 12½).

between Sc proper, proximal to the nodus, and Scspl distal from it, can be clearly seen, so that the second branch of Sc spoken of, on p. 680, as apparently running straight through the nodus, does not really exist at all. It can also be seen, that the supposed third branch mentioned on the same page is non-existent, being none other than the downward production of the nodal cross-vein itself, which curves round, posteriad and distad, to meet R at the *subnodus* (Sn). At this point the vein, which is clearly the true Radial Sector (Rs) comes off posteriad from R,

and shows a slight curving close to its origin. This Rs crosses from R to M obliquely, reaching the latter *just after it has divided into* M_1 and M_2, and crosses over both these branches. It then becomes a very weakly-formed vein, which drops less obliquely towards Ms, but fails to reach it, being caught up at the upper proximal angle of a small, but clearly-marked, trapezoidal cellule standing upon Ms itself.

This formation certainly supports the theory, advanced by me in a previous paper, concerning the true nature of the Bridge in Anisoptera(3)—written before I had seen this fossil—except in one particular. I suggested that, in the Anisoptera, trachea Ms "becomes hitched on to Rs," so that the bridge itself represents, in the imaginal venation, the original course of Ms, while its distal prolongation beyond the oblique vein (this latter represented in our fossil by the piece of Rs lying below M_2) represented Rs (*l.c.*, pp.883-4). Now, in our fossil wing, Rs practically fails to reach Ms, so that the natural interpretation of the venation is that not only the bridge itself, but also its continuation right to the wing-border, belongs altogether to Ms, while Rs only forms the subnodal vein between R and M_1, the minute crossing between M_1 and M_2, and the *incomplete oblique vein* (O) descending towards Ms, but failing to reach it. A very little advance in specialisation in this latter region would straighten out the lower end of Rs, so that the oblique vein would appear completed, as in all recent Anisoptera.*

Woodward's figure correctly shows the point of crossing of Rs over M, and its failure to reach Ms, but quite fails to give the peculiar and distinctive features of the nodus itself, and the dense structure of the cellular meshwork in that region.

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* It is possible that Rs actually continues along the zigzag between M_2 and Ms for three cellules' distance, so that, if further evolution simplified this part to single cross-veins, the slanting vein marked O′ in the figure might appear as an "oblique vein." This process might account for the carrying on of the oblique vein far beyond the level of the nodus in *Æschnidium*, and in many recent Anisoptera.

We may summarise the chief points of interest in this region of the wing as follows:—

(1) The nodus is fully formed, but weak.

(2) The subnodus is also complete.

(3) The apparent prolongation of Sc through the nodus is of the same nature as that seen in *Telephlebia*, i.e., due to the secondary formation of a supplement between C and R, by alignment of the boundaries of numerous cellules of the dense meshwork to form a *subcostal supplement*, Scspl; but, in the fossil, this Scspl is completely formed, whereas, in *Telephlebia*, it is of only about two cellules' length.

(4) Supplements similar to Scspl, and due to the same cause, are formed proximally to the nodus, between C and Sc, and distally from the nodus, between C and Scspl; but the latter of these does not reach back proximally to the nodus (see Plate xliii., fig.11).

(5) Rs arises from R directly under the subnodus. It is a weak vein, running obliquely to M, crossing M_1 and M_2 not far distad from their point of union, and then dropping towards Ms as the incomplete, oblique vein O.

It will be seen that, if this fossil gives us the right interpretation of the structure of Rs and Ms, the distinction between the Anisoptera and Zygoptera in this region almost disappears. The only difference would be that, in the former, trachea Rs has become strengthened by capturing Ms, so that the basal part of the latter (the bridge) has become aborted; while, in the latter, it continues to weaken, and fails ever to cross M_{1+2}.

Classification of the Fossil Wing.

As long as we decide to keep to the old classification of the Anisoptera, in which only two families are recognised (the *Æschnidæ* and the *Libellulidæ*), it seems to me that we cannot grant full family-rank to the *Æschnidiidæ*. These latter have the triangles of the fore- and hindwings alike (both being elongated transversely to the wing-axis), and the antenodals of the first and second series not corresponding. Hence they are,

within the broad definition of that family, true *Æschnidæ*. I propose, therefore, to regard Handlirsch's family *Æschnidiidæ* as only a subfamily, *Æschnidiinæ*, within the family *Æschnidæ*, and of equivalent rank with the subfamilies *Petalurinæ*, *Cordulegastrinæ*, and *Chlorogomphinæ*. This last group, I consider to be the nearest living type to the fossil *Æschnidiinæ*, owing to the shape of its triangles.

At present, the fossil wings (Jurassic and Cretaceous) assigned to the subfamily *Æschnidiinæ* are all comprised within the single genus *Æschnidium* Westwood. I now propose to separate out the Queensland fossil wing as the type of a distinct, new genus, *Æschnidiopsis*, according to the following Table:—

Subfamily ÆSCHNIDIINÆ.

Key to the Genera.

Areulus complete posteriorly; triangles not excessively narrowed transversely to the wing-axis .....Genus *Æschnidium* Westwood. (Jurassic, Europe). Type, *Æschnidium bubas* Westwood. (Lower Purbecks, Durdlestone Bay, England).

Areulus incomplete posteriorly; triangle of hindwing excessively narrowed and elongated transversely to the wing-axis ....Genus *Æschnidiopsis*, n.g. (Cretaceous, Australia). Type, *Æschna flindersiensis* Woodward. (Flinders River Beds, N. Queensland).

ÆSCHNIDIOPSIS, n.g.

Large Dragonflies (hindwing about 40 mm. long) with exceedingly dense reticulation, as in *Æschnidium*. *Nodus* completely formed, but weak; *subnodus* also present. Rs arises at the subnodus, crosses M_1 and M_2 just distad from their point of union, and drops towards Ms as an incomplete, oblique vein. (In *Æschnidium*, as figured by Handlirsch, the oblique vein is complete in the hindwing, and lies far distad from the nodus). *Areulus* strongly formed, but incomplete posteriorly; M_{1+3} leaving it very close up to R; M_4 lying well below M_{1+3}, separated from the latter by two rows of cellules. *Triangle* of hindwing very long, and excessively narrowed transversely to the wing-axis; crossed by a number of simple, subparallel cross-veins;

either quadrangular in form (closed posteriorly by the thickened cross-vein *de* of Text-fig. 9), or open posteriorly; far removed from arculus. *Subtriangle* broad, quadrangular, filled with a mesh-work of irregular cellules; probably narrowly open posteriorly. Mspl well-developed, slightly concave to M_4. Rspl apparently fairly well-developed. *Anal crossing* not clearly indicated. *Anal vein* with at least seven, well-formed, convex, descending branches in hindwing, subparallel, separated by concave supplements.

Type, *Æschna flindersiensis* Woodward.

ÆSCHNIDIOPSIS FLINDERSIENSIS (Woodward).

Æschna flindersiensis Woodward, Geol. Mag., New Series, Dec. iii., Vol. i., No. viii., 1884, pp.337-339, Plate xi., fig.1.

Æschnidium flindersiense Handlirsch, Die fossilen Insekten, p.667.

Total length of specimen (hindwing) measured along the radius, 22·5 mm. *Greatest breadth* (at level of origin of Ms), 12·6 mm. Probable total length of wing, about 40 mm.

Description as given in this paper.

Locality.—Flinders River Beds (Cretaceous), N. Queensland.

Type in Coll. Queensland Geol. Survey, Brisbane, Q.

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3. TILLYARD.—"Further Researches upon the Problems of the Radial and Zygopterid Sectors in the Wings of Odonata, and upon the Formation of Bridges." Proc. Linn. Soc. N. S. Wales, 1916, Pt. 4, pp. 871-887. (See p.883).

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5. WOODWARD.—"On the Wing of a Neuropterous Insect from the Cretaceous Limestone of Flinders River, North Queensland, Australia." Geol. Mag., New Series, Dec. iii., Vol. i., No. viii., 1884, pp.337-339, Plate xi., fig.1. (*Æschna flindersiensis*).

EXPLANATION OF PLATES XLII.-XLIII.

Plate xlii.

Figs.9-10.—*Eschnidiopsis flindersiensis* Woodward, hindwing; photographed by strong oblique, artificial light; (×4). In Fig.9, the light is directed from the left; in Fig.10, from the right.

Plate xliii.

Fig.11.—*Eschnidiopsis flindersiensis* (Woodward), hindwing; (×6). Camera lucida drawing to show full details of venation.

Lettering for Plates and Text-figures.

A, analis; A_1-A_7, its descending branches; *arc*, arculus; C, costa; Cu, cubitus; Cu_1, Cu_2, its branches; *de*, thickened cross-vein in triangle; *f*, *g*, struts supporting subtriangle; M, media; M_1-M_4, its branches; Ms, Zygopterid sector; Mspl, median supplement; N, nodus; Nc, nodal cross-vein; O, oblique vein (incomplete); O′, possible second oblique vein; R, radius; R_1, its main stem; Rs, radial sector; Rspl, radial supplement; Sc, subcosta; Scspl, subcostal supplement; Sn, subnodus; *st*, subtriangle; triangle; *x*, cross-vein tending to complete arculus posteriorly.

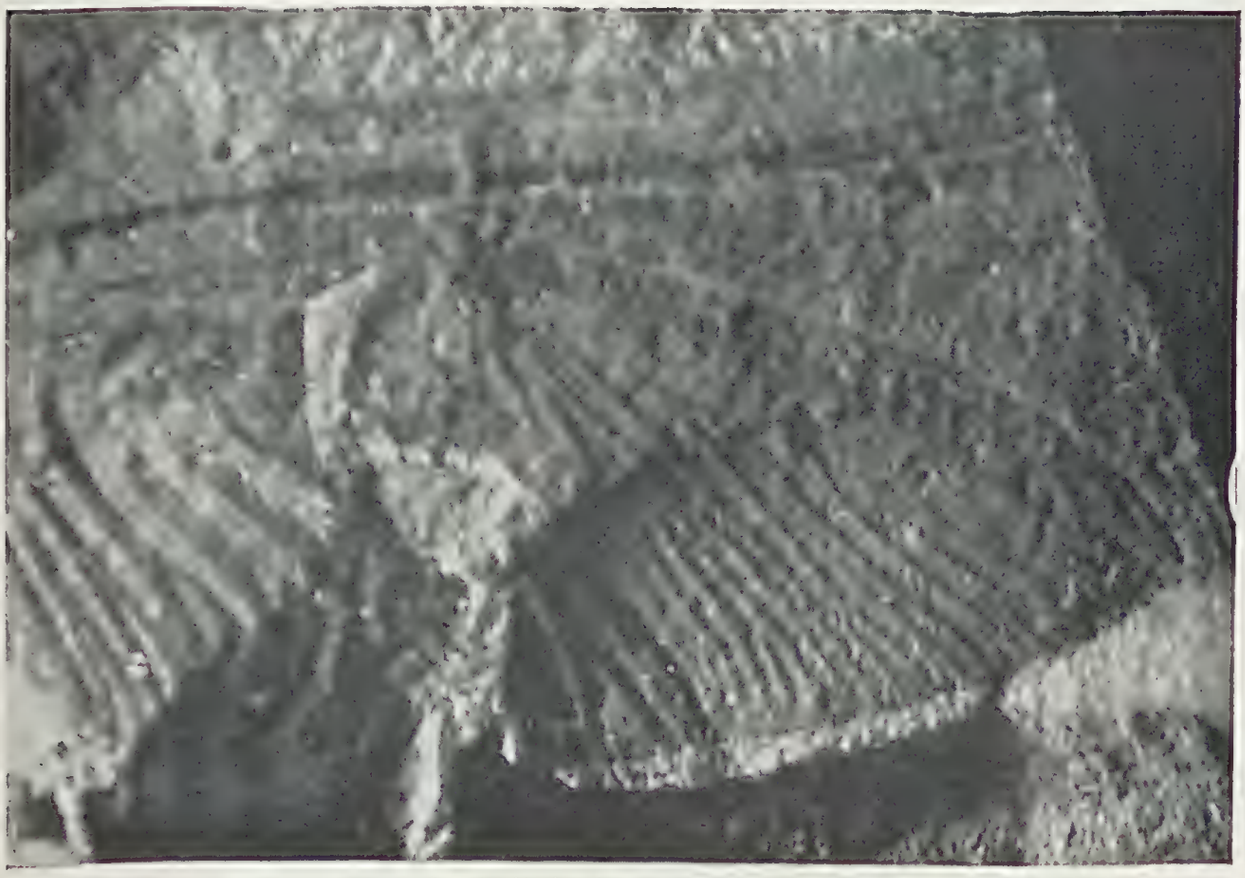


Fig. 9. *Æschnidiopsis flindersiensis* (Woodward) ; hindwing; (×4).

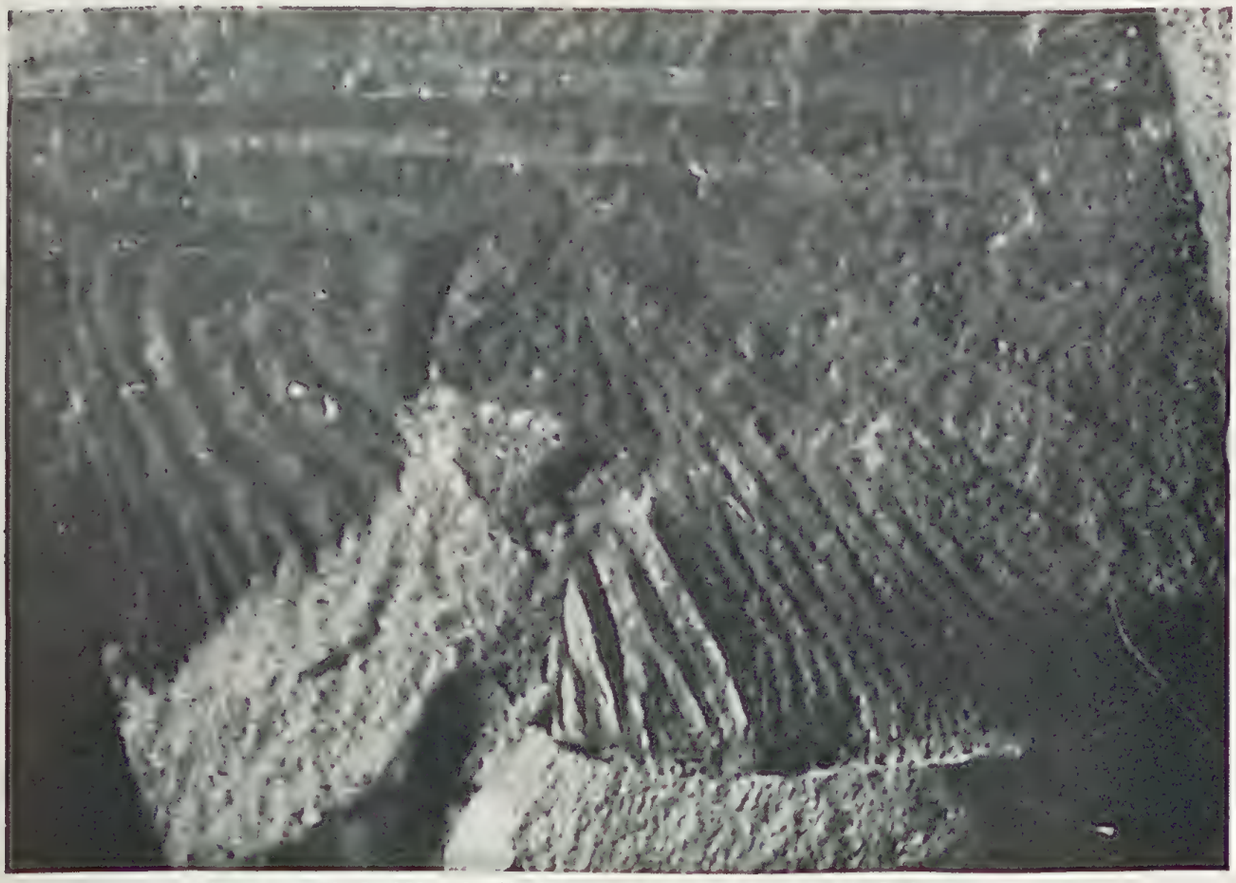


Fig. 10. *Æschnidiopsis flindersiensis* (Woodward); hindwing; (×4).

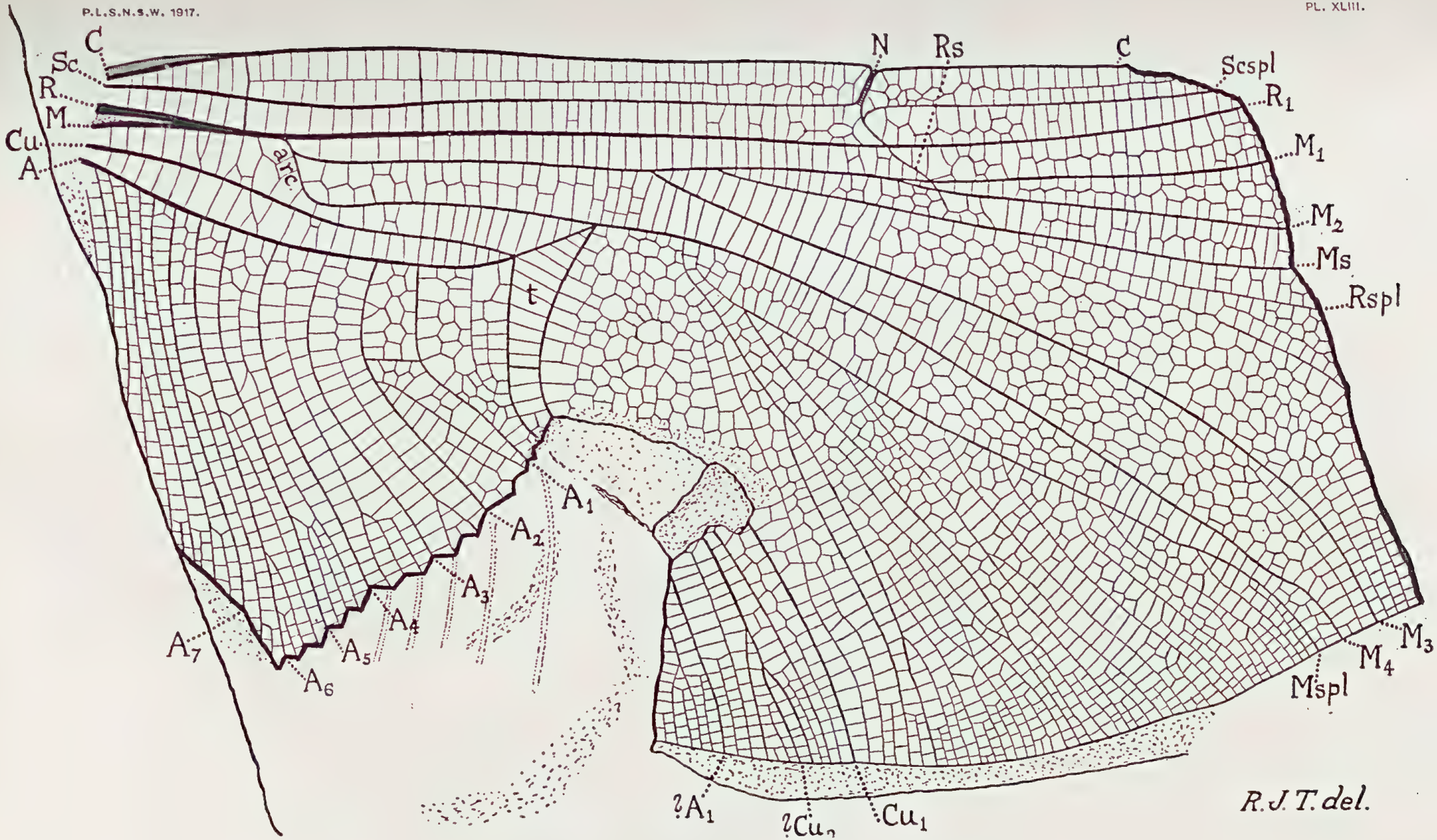


Fig. 11. *Æschnidiopsis flindersiensis* (Woodward); hindwing; (×6).

England, together with a number of older forms, apparently relics of the old Carboniferous Fauna, such as we know from Commentry in France. The three insects described in this Part illustrate this intermingling of forms very clearly.

Order **ODONATA.**

Suborder **Zygoptera.**

Family LESTIDÆ.

Subfamily TRIASSOLESTINÆ, n.subfam.

Wings with the bases strongly reduced, petiolate; the whole of the area between Cu and the posterior margin, below the quadrilateral, free of veins; and, hence, no anal bridge present. Quadrilateral narrow, placed very obliquely to the long axis of the wing; its upper side short, its lower long, and hence its distal angle very acute; Cu_1 and Cu_2 arising together from this angle. Arculus complete, with M_{1-3} arising from the top of the quadrilateral.

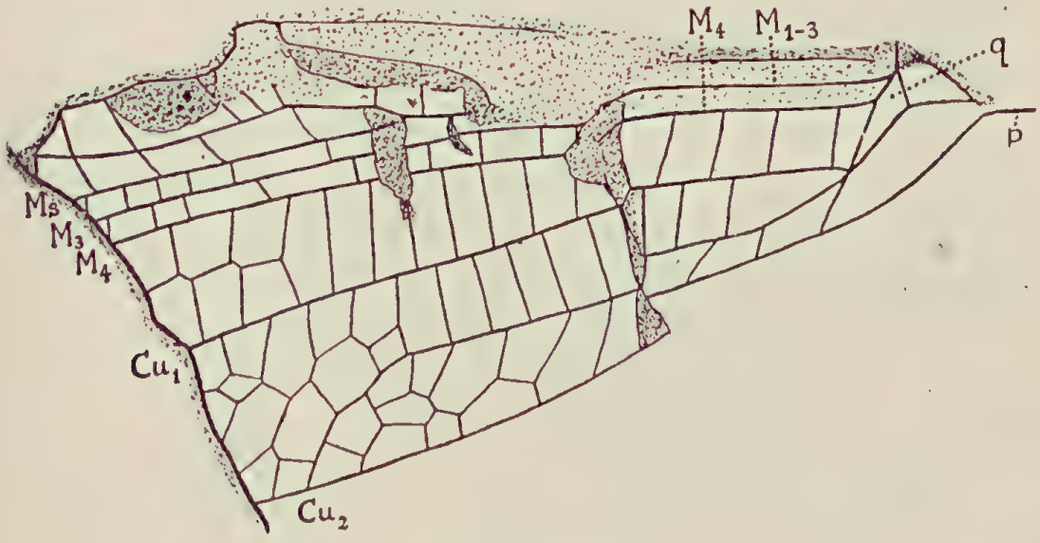
Genus TRIASSOLESTES, n.g. (Text-figs. 11, 12*b*).

A complete antenodal cross-vein in line with the arculus; (this is probably the second of the series). Distal side of quadrilateral continued straight to the posterior border of the wing, by an oblique cross-vein. M_{1-3} arching slightly upward as each branch is given off; M_3 arises about six cells distad from the level of the quadrilateral; Ms arises from M_{1-2} about four cells further distad than M_3. Discoidal field fairly wide, with M_4 and Cu_1 slightly divergent; a single row of cells to beyond the level of the origin of Ms, followed further distad by two rows. Between Cu_1 and Cu_2, a single row of cells at first, to about level of origin of Ms. Cu_2 curves strongly downwards distally to meet the posterior border of the wing; between it and the wing-border, one row of cells basally, increasing to two distally. [Anterior and distal portions of the wing missing, including nodus and pterostigma].

Genotype, *Triassolestes epiophlebioïdes*, n.sp. (Upper Triassic, Ipswich, Queensland).

Triassolestes epiophlebioides, n.sp. (Text-figs. 11, 12*b*).

A well-preserved fragment, 18·5 mm. long, greatest width (distally) 8·5 mm.; consisting of the greater portion of the basal half of the wing, but without the extreme base. The anterior part, including the costa, subcosta, and radius, missing. The preserved portion includes the quadrilateral, the media and cubitus with their branches, and the posterior border of the wing. The anal vein appears to be completely fused with the latter.



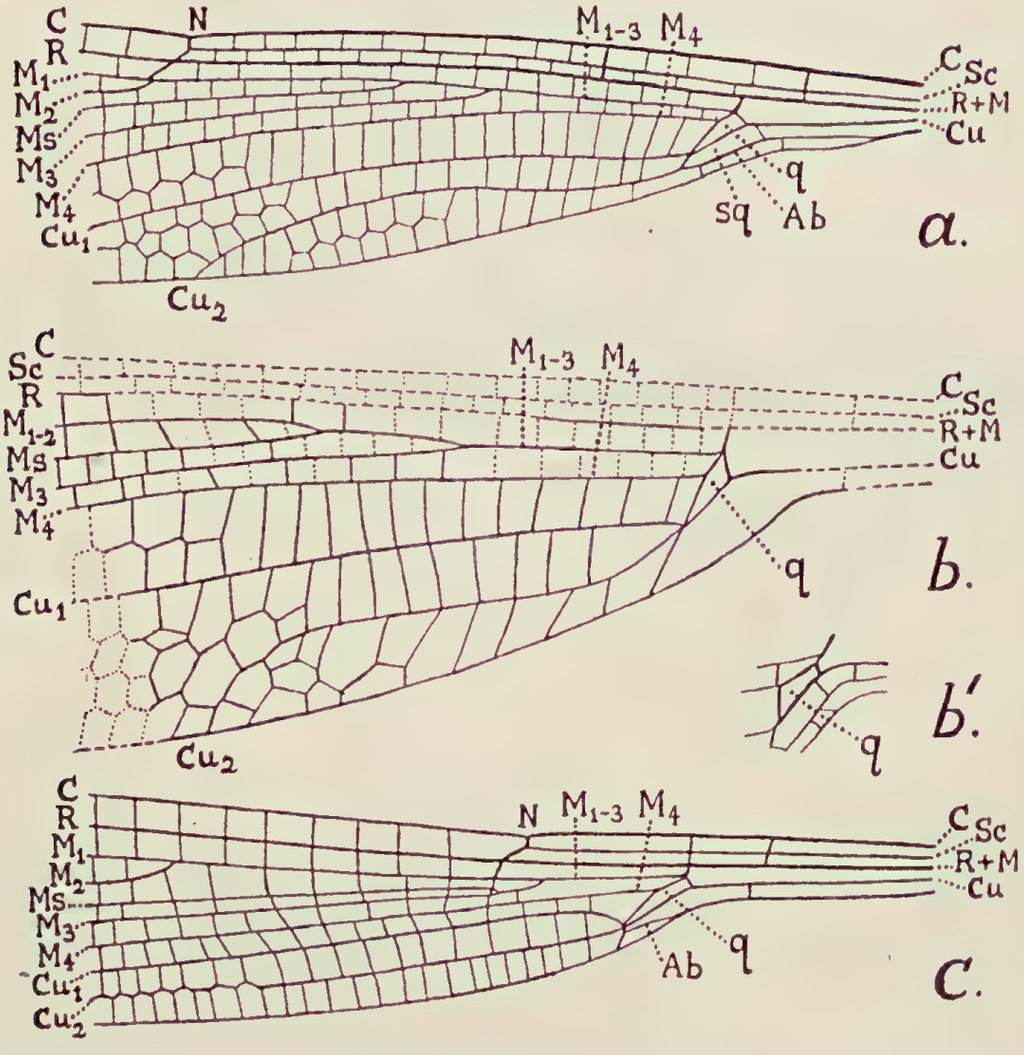
Text-fig. 11.

Triassolestes epiophlebioïdes, n.g. et sp., (Triassic, Ipswich, Q.), preserved portion of wing; (×5). Cu_1, Cu_2, branches of cubitus; M_{1-3}, upper, and M_4, lower sector of arculus; Ms, Zygopterid sector: *p*, petiole; *q*, quadrilateral.

The appearance of the fossil may be seen from Text-fig. 11. The veins are all beautifully preserved, but unfortunately the wing lies upon some plant-remains, which appear to have been hard twigs or stems, and which have caused the fossil to rest upon a very uneven surface; with the result that, in one place at least, the wing has become crumpled or torn transversely, so that the continuity of the main veins is badly broken. The veins can, however, be followed across the break, and picked up on the other side of it. Distally also, in the region of M_{1-2}, the wing lies upon an uneven surface, and the position of both main veins and cross-veins is somewhat distorted.

Eliminating the effect of these inequalities, it is not a difficult

task to restore the wing to its correct form, as far as it is preserved for us. The result is to be seen in Text-fig. 12*b*, to which I have added the probable courses of the veins that are missing in the fossil. For purposes of comparison, I have shown also the



Text-fig. 12.

(*a*) *Epiophlebia superstes* (Selys), (Recent, Japan), forewing; *b'*, region of quadrilateral of hindwing of same. (*b*). *Triassolestes epiophlebioïdes*, n.g. et sp., (Triassic, Ipswich, Q.), restored wing, with missing parts shown by dotted lines. (*c*) *Synlestes weyersi* Selys, (Recent, Australia), forewing. The basal portions of all three wings shown for comparison with one another, (all × 4). Ab, anal bridge; C, costa; N, nodus; R, radius; *sq*, subquadrangle. Rest of lettering as in Text-fig. 11.

corresponding areas of the forewings of *Epiophlebia superstes* (Selys), and *Synlestes weyersi* Selys, both of which show certain points of resemblance with this interesting new fossil.

Comparing the fossil first of all with *Epiophlebia*, we note that

the fossil wing was considerably broader, and probably also somewhat longer. The region of the quadrilateral is closely similar in both, but the quadrilateral of the fossil wing is placed more transversely to the wing-axis, and the lower portion of the arculus is much more transversely placed than in *Epiophlebia*. The quadrilateral of the fossil resembles that of the forewing of *Epiophlebia* (Text-fig. 12*a*) much more than it does that of the hindwing (*b'*); but, in other respects, particularly in the strong distal curvature of Cu^2, the fossil wing more resembles the hindwing. A close resemblance to *Epiophlebia* is shown in the levels of the origins of the branches of M, and in the shape and venation of the discoidal field and the two longitudinal areas of the wing lying below it.

The fossil, however, differs entirely from *Epiophlebia*, and, indeed, from all known *Lestidæ*, in possessing a broad and absolutely free area between Cu and the posterior border, below the quadrilateral. As the wing is excellently preserved in this region, there can be no doubt about this character, which places the fossil, in this respect, as more highly specialised by reduction than any known Zygoptera, except only the subfamily *Protoneurinæ* of the family *Agrionidæ*.

Where the nodus was placed, we cannot tell for certain. But, if we were agreed that the comparison with *Epiophlebia* would hold also for this character, we might expect that it was situated somewhere near the extreme distally preserved portion of the fossil, *i.e.*, considerably distad from the level of the origin of Ms.

The comparison with *Synlestes* is by no means so close, as can be seen from Text-fig. 12*c*. The wing of *Synlestes* is exceedingly narrow, and differs from that of the fossil in having Ms arising from M_3 close to its origin, in the very narrow quadrilateral, in the upward arching of Cu_1 from the distal angle of the quadrilateral, in the consequent narrowing of the discoidal field, and in the length and straightness of Cu. But, in its extreme reduction of the anal bridge (*Ab*), *Synlestes* shows the nearest existing approach to the high specialisation seen in the fossil; and, on this account, the comparison is of value.

While placing this fossil as more closely allied to *Epiophlebia* than to any known Dragonfly, fossil or recent, it seems to me that the characters exhibited by it require its elevation to subfamily rank. But, if the area below the quadrilateral had possessed an anal bridge, I should have been content to place it in the subfamily *Epiophlebiinæ*.

The Lestid affinities of the fossil appear to me to be beyond doubt. As it appears that some students of the Odonata have been unwilling to accept my removal of *Epiophlebia* to the family *Lestidæ*, I should now like to draw their attention to this fossil, which was unknown at the time that I made this suggestion. The combination of Epiophlebiine characters from the quadrilateral distad, with the extreme reduction of the base, which characterises this fossil, should surely be regarded as a further link in the chain of evidence for the Lestid affinities of *Epiophlebia*.

Type, Specimen No. 205*a*, (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

ODONATA INCERTÆ SEDIS.

Genus PERISSOPHLEBIA, n.g. (Text-fig. 13).

Between C and R, beyond pterostigma, an irregular double row of cells. Between R and M_1, beyond level of pterostigma, at first an irregular triple row of cells, followed by a more regular double row. Below M_1, a strong convex sector is developed towards the apex of the wing, three rows of cellules from it. This is probably M_{1A}. Close below this sector, and only a single row of cells' width from it, there is a parallel concave sector. Both the above sectors converge towards M_1 as they approach the apex of the wing. Some three or four rows of cells below the concave sector, there is a diverging convex sector, which is probably M_2.

[Only a fragment of the wing is preserved, embracing a portion beyond the pterostigma].

Genotype, *Perissophlebia multiseriata*, n.sp. (Upper Triassic, Ipswich, Q.).

So little of the wing of this fine Dragonfly is preserved, that it would be inadvisable to name it, were it not for the very remarkable characters exhibited by the preserved portion of the wing. It may be stated as a general rule, both for recent and fossil Odonata, that the spaces between C and R, on the one hand, and between R and M_1, on the other, from the level of the pterostigma to the apex of the wing, are only filled by a single row of cells. As exceptions to this, we may note the Liassic genus *Petrothemis* Handl., in which the distal portion of the space between C and R is filled with three rows of minute cells, and the basal portion of the space between R and M_1 carries two rows of cells near the pterostigma, decreasing to one row only towards the apex; and the very densely-veined *Aeschnidiidæ*, in which the upper of the two spaces in question has only one row of cells, but the lower has two.

Hence we see that, on this character alone, *Perissophlebia* stands as the most densely veined of all known Odonata.

A second character, that is very exceptional in Odonata, is the arrangement and direction of the longitudinal veins lying below M_1. These are so strongly developed that they would appear, at first sight, to be portions of main veins. But a little consideration of the position of the pterostigma shows us that the preserved portion of the wing represents only a very small piece of a very large wing. The lowest of the three sectors seen below M_1 in the fossil is concave, and may very probably be M_2; the other two are almost certainly not branches of M, but intercalated sectors. Of these latter, the upper one, being strongly convex, very probably corresponds with the *postnodal sector*, M_{1A}, found in recent Zygoptera and in *Petalura*; while that below it might be either a concave supporting sector, or a branch from M_2 itself. In any case, the directions of these three veins, two being parallel to one another but converging towards M_1 distally, and the third being parallel to M_1, are quite exceptional in the Odonata.

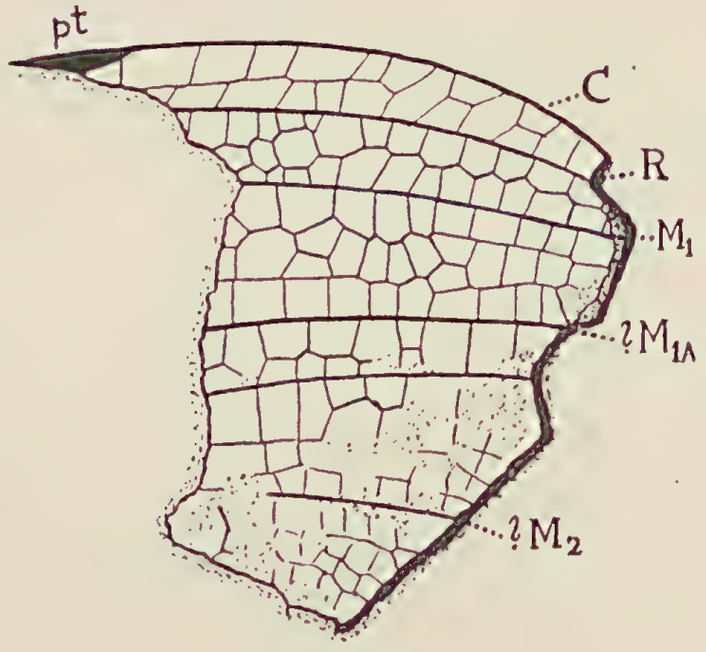
It is clear then that, in spite of the small amount of the wing preserved, the characters there shown are quite marked enough to warrant the giving of a name to the fossil.

PERISSOPHLEBIA MULTISERIATA, n.sp. (Text-fig. 13).

Total length of fragment, 8·5 mm.; greatest breadth of same, 8·5 mm.

A small portion of the pterostigma preserved appears to point definitely to the fact that it was sharply angulated at its upper distal angle; a character that is exceptional amongst fossil Odonata.

Most of the fragment is very well preserved, with the cross-veins clearly visible; but, in the lower portion, they are partly obliterated.



Text-fig. 13.

Perissophlebia multiseriata, n.g. et sp., (Triassic, Ipswich, Q.). Preserved portion of wing, (×7½). M_1, postnodal sector.

The distance from the tip of the pterostigma to the apex of the wing, and the great width of the wing beyond the level of the pterostigma, both point to the fact that it is a fragment of a very large wing, probably as large as, or larger than, that of *Petalura gigantea* Leach.

Type, Specimen No. 203 *a-b* (part and counterpart). (Coll. Queensland Geological Survey).

It is impossible to place this fragment definitely; but I would

suggest a likely relationship with *Petrothemis singularis* Handlirsch, which is itself unplaced, owing to absence of the basal half of the wing. A figure of this latter fossil is given in Handlirsch's Atlas(1), Plate xlii., fig.9. It is a much smaller wing than that of *Perissophlebia*, and comes from the Upper Lias of Dobbertin, Mecklenberg.

Order **PROTODONATA.**

Suborder **Aeroplanoptera**, subordo nova.

Insects with strongly veined wings, traversed by numerous parallel longitudinal veins, with a network of irregular cross-veins, well developed near the base only; in the rest of the wing, the cross-veins tend to become weak, and almost disappear distally. Costal border strongly developed, coriaceous at base. Radius with a single sector. Media with many dichotomous branches. Cubitus two-branched.

This Suborder is at once distinguished from all the rest of the Protodonata (which may be termed the Suborder Meganeuroptera, from the dominant family) by the close, parallel veining of the wings, the dichotomous branchings of the media, and the two-branched cubitus. In this latter character, it agrees with the Order Odonata; whereas the rest of the Protodonata have only a simple cubitus.

Family AEROPLANIDÆ, fam.nov.

Wings excessively elongated and narrow, the parallel longitudinal veins strongly developed and close together. Subcosta weak, in a deep groove just in front of the exceedingly strongly developed radius. The single radial sector arising from near the base *by a double root*. Media seven-branched in both wings, but the method of branching is different in fore- and hindwings. Radius and media just fused at bases. Cubitus with its two branches arising close to the base and diverging gradually. A single anal vein present, below which is developed an anal field with irregular veining, supported by a curved recurrent supplement.

Genus AEROPLANA, n.g. (Plates xliv.-xlv., Text-figs. 14, 15).

Characters of the family, with the following additions. First and second origins of Rs arising not far apart, the portion between them somewhat curved concavely to R. First dichotomy of M at same level as first origin of Rs. In forewing, the anterior branch of M gives rise to three branches, by two dichotomies which take place at some distance from the first; the posterior branch also gives rise to three branches, which arise much closer to the original forking. The middle of these three last branches forks again, a little further distad. Thus there are seven branches in all, three arising from the anterior branch, and four from the posterior. In the hindwing, the anterior branch of M remains simple for a considerable distance, but finally divides into two only; the posterior branch, on the other hand, soon divides again into two, of which the upper branch gives rise to three branches by two separate dichotomies, the lower to two only. Thus there are also seven branches of M in the hindwing, but of these only two arise from the anterior branch, and five from the posterior.

The two branches of Cu diverge very slightly from one another at first, both tending to diverge also from the radius, in the same manner that the media does. A little further distad, close to the level of the first origin of Rs, Cu_2 begins to curve strongly away from Cu_1, forming a wide bend, and later on again approaches Cu_1, to run parallel to and beneath it.

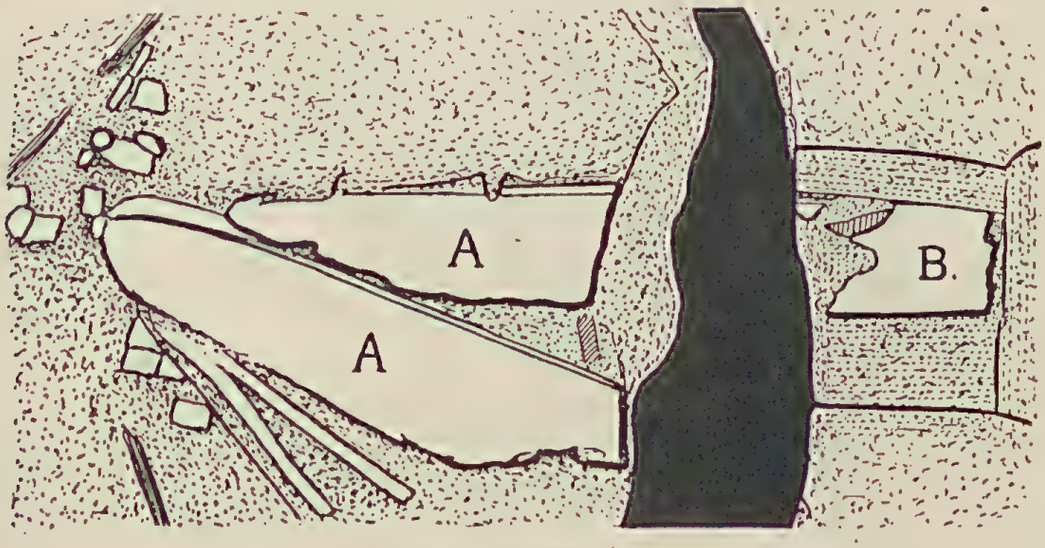
Just distad from the first dichotomy of M, in the hindwing only, a weak, curved supplement runs back obliquely to join Cu_1, resembling in form the anal supplement below A, but on a smaller scale.

Genotype, *Aëroplana mirabilis*, n.sp. (Upper Triassic, Ipswich, Q.).

AEROPLANA MIRABILIS, n.sp. (Plates xliv.-xlv., Text-figs. 14, 15).

Total length of fossil as preserved, from base of hindwing to end of isolated piece of forewing, 41·5 mm. Total length of preserved portion of hindwing, 26 mm.; greatest breadth of same, 5 mm.

The insect lies upon the somewhat uneven surface of a dark grey shale, in such a position that it is crushed down somewhat dorso-laterally, the hindwing apparently covering the thorax, and having its costal margin passing under the posterior border of the forewing. This latter wing, however, lies at a slightly higher level; so that, in the process of delamination, its posterior border was lifted off, exposing the whole basal portion of the costal



Text-fig 14.

Aëroplana mirabilis, n.g. et sp., (Triassic, Ipswich, Q.). Sketch of the whole fossil *in situ*, (× 2) to show the relative positions of the different parts. A, A, principal portions of the fore- and hindwings, figured in Plate xliv., fig 12; B, distal portion of forewing, figured in Text-fig. 15. To the left of the wings are shown the crushed portions of the head and thorax. The fossil remains are left unshaded, the rock itself is lightly shaded, and the deep break between the parts A and B is shown in black. The rock around B has been partly cut away with a penknife.

margin of the hindwing. Around the bases of the wings there are scattered a number of chitinous pieces, some belonging to the head, and some to the thorax of the insect. These are so much crushed that they cannot be recognised with certainty; but there are two very concave impressions close together, one circular and the other an irregular oval, which may represent portions of the compound eyes. Below the hindwing, there are two narrow elongated fragments, one about 14 mm. long, the other about

11 mm., which appear to represent the broken-off costal borders of the other pair of wings.

Mr. Dunstan tells me that, in the search for this fossil, the rock broke transversely across the two wings, leaving a considerable gap between them. On the other side of this break, Mr. Dunstan prospected with his penknife, and was fortunate in picking up a further (more distal) portion of the forewing, lying exactly in line with the more basal portion. This part was glued into position on cardboard with the rest of the fossil, as shown in Text-fig. 14. Mr. Dunstan assures me that this part is not, at the most, more than a sixteenth of an inch out. If that be so, as it certainly would appear to be from the shape of the wing, then it is clear that the wings of this insect were excessively long and narrow, being in shape not unlike the planes of a modern aëroplane. This character suggested to me the name of the genus.

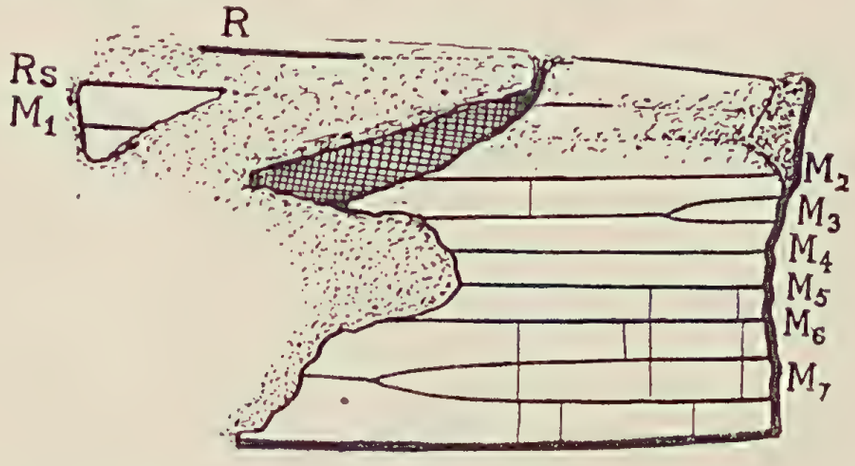
The general character of the wings of the fossil can be well seen from Plate xliv., fig. 12. The hindwing is very complete as regards its basal portion, and exhibits a large number of interesting characters. We may most profitably study this wing first.

The costal space appears to be strongly convex, and was probably formed of very hard chitin, since the few cross-veins in it are indistinct, and the whole area appears to have been coriaceous in texture. The convex curvature of this area ends posteriorly in the deep groove of the subcosta, behind which the radius rises strongly up again as a convex vein. The two separate bases of Rs are both strongly marked veins, but the base of the media appears as a very weak vein diverging from R. The bases of Cu and A are strong veins.

In the whole of the basal region of the wing, up to a leve just beyond the second origin of Rs, the cross-veins are strongly marked and easily followed. The meshwork here is of a typical Palæodictyopterous type, the cells formed being very irregular in shape. The development of the recurrent supplements between M and Cu, and again between A and the posterior border, in the

hindwing, are clearly interesting attempts to strengthen the wing in the region of greatest curvature of the main veins.

Beyond the level of the origin of Rs, the cross-veins become weaker, and are difficult to make out. In the figure in Plate xliv., I have indicated every possible cross-vein of which I can find traces, by examination in lights of different directions and intensities. Some of these may not be true cross-veins, while there may be others present which I have missed.



Text-fig. 15.

Aëroplana mirabilis, n.g. et sp., (Triassic, Ipswich, Q.). Distal portion of forewing beyond the transverse fracture of the rock shown in Text-fig. 14; ($\times 7\frac{1}{2}$).

The preserved part of the forewing is very similar to the hind, except for the different manner of branching of the media, which has been already mentioned. Careful measurements of corresponding portions of fore- and hindwings show that their widths are almost the same, the forewing being slightly wider than the hind, as judged by the perpendicular distance between Rs and Cu_1. But this may have been offset by a somewhat wider anal area in the hindwing.

The isolated distal portion of the forewing is shown in Text-fig. 15. The main veins are well-preserved, yet there are few indications of cross-veins. It seems probable that the cross-veins became weaker and weaker towards the distal end of the wing, and finally became obsolescent near the tip, so that most of them are not preserved in the fossil. It will be seen that there are

two bifurcations in this distal part of the wing; these have to be taken into account in the restoration of the fossil, which I have attempted below.

Type, Specimen No. 126*a*. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

Restoration of the Wings of Aëroplana mirabilis, *n.sp.*
(Plate xlv., figs. 13-14).

In attempting to restore the complete wings of this remarkable fossil, I have made two assumptions which appear to be fairly well justified, viz., that the shape and venation of the fore- and hindwings were approximately the same (with the principal differences preserved to us in the fossil as it stands), and that the isolated portion of the forewing, shown in Text-fig. 15, lay close to the apex of the wing.

Even with this latter proviso accepted, and taking full advantage of the possibility of an error of one-sixteenth of an inch in Mr. Dunstan's placing of this fragment, it will be apparent that the length of the wings, in comparison with their breadth, is enormous, the ratio being approximately 7 : 1.

In filling in the gap between the basal half of the forewing and the distal preserved portion, it is necessary to bear in mind the possibility of one or more veins having reached the costal or posterior border, respectively, in the interval. To determine this, I examined the veins in the distal fragment carefully, with the result that I found the uppermost to be more strongly built than the others. This should, therefore, be the radius, as is also evident from its level on the wing itself. Hence, if we assume that there have been no other dichotomies of veins in the missing part of the wing, the veins below R in this part of the wing must be, in consecutive order, Rs and the seven branches of M. Of these last, it will be seen that M_3 and M_4 branch again. There remain, then, as veins that have reached the posterior border of the wing before this level, the two branches of Cu, and A.*

* This interpretation assumes no further dichotomies of M in the missing portion of the wing.

On the above suppositions, we may restore the two wings as shown in Plate xlv., figs. 13-14, the missing portion of each wing being made approximately the same as the corresponding portion present in the other.

The total length of the wings, as restored above, would be about 46 mm. each. If, then, the insect were of slender build, with a narrow thorax, the total expanse of the wings must have been about 96 mm., or nearly four inches. This is very small for a Protodonate; but the fossil bears the marks of a reduced type.

Affinities of the Fossil.

This fossil is certainly one of the most puzzling of all the Ipswich Insects. As far as I know, there is nothing in the whole range of insect-venation, either fossil or recent, that shows any close relationship to it. In finally determining to place it in a new Suborder within the Protodonata, the following points have weighed with me:

(1). The differences in the branchings of the media, in the two wings preserved, are sufficient proof that we have a fore- and a hindwing preserved, not two forewings or two hindwings.

(2). Which wing is the fore and which is the hind, is not capable of absolute proof. But, unless the insect is altogether twisted out of shape, the more anterior one should be the forewing, as I have assumed it to be.

(3). The close similarity evident between fore- and hindwing in venation, as well as in shape, puts several Orders out of court at once; notably the Orthoptera, the Perlaria, and the Homoptera.*

(4). In considering the type of venation exhibited, there would appear to be characters belonging to three Orders, viz., the Protodonata, Planipennia, and Mecoptera. These characters had to be carefully weighed, with reference to known types of each Order.

* We might note here the existence, in Australia, of Homoptera belonging to the subfamily *Derbinæ* of the family *Fulgoridæ*, with the forewing narrowly elongate as in *Aëroplana;* also, a similar elongation occurs in both wings in the genus *Stenobiella* of the family *Trichomatidæ*, in the Order Planipennia.

(5). In the above comparison, due allowance must be made for reduction of the original venation, owing to the extreme narrowing of the wing.

Taking, then, the Mecopteran characters first, it will be seen that these may be practically summed up in the dichotomous nature of the branchings of the media. But, in the Mecoptera, the radial sector undergoes a similar series of dichotomous branchings. We must assume, then, that this type of branching is not in itself evidence of Mecopteran affinities, unless accompanied by other definite characters. That this is certainly so is shown by the archaic *Psychopsis illidgei*, which belongs to the Planipennia, but which has, nevertheless, a media dichotomously branched, in a manner not unlike that of the fossil.

The Planipennian affinities suggested are the general appearance of the wings as being those of a "lacewing," with their numerous parallel longitudinal veins supported by, for the most part, delicately formed cross-veins; the great strength of the radius, and the close, parallel situation of the subcosta in a deep groove in front of it; and also the correspondence between the branchings of M in the fossil and in *Psychopsis illidgei*, already mentioned.

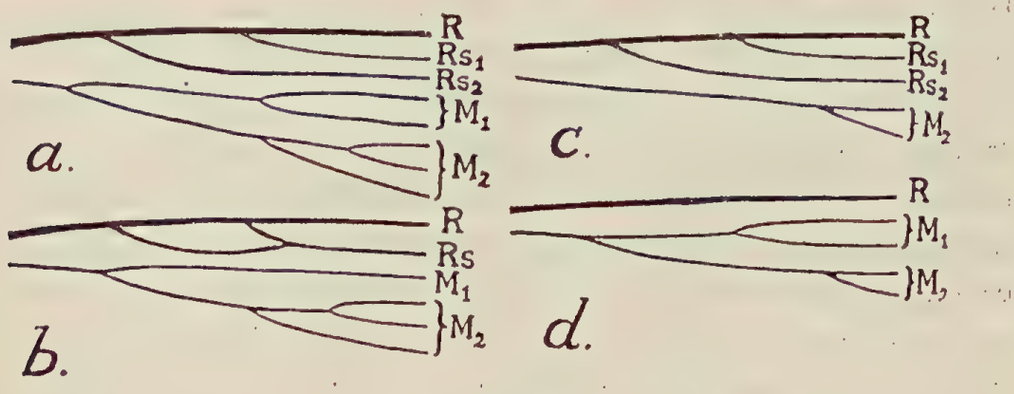
The principal characteristic of all known Planipennia, however, is the large number of descending branches of the radial sector. It is these veins that form, in this Order, the majority of the parallel longitudinal or oblique veins traversing the wing. But, in the fossil, Rs is unbranched. This alone seems quite sufficient to prevent us placing the fossil within the Planipennia. Further, in all archaic Planipennia, the series of cross-veins between C and Sc is oblique; whereas, in the fossil, those that can be seen are at right angles to the main veins, as in Odonata and Protodonata.

A further argument against both Mecopteran and Planipennian affinities for this fossil is the absence of any signs of *macrotrichia* upon the main veins. Even the strongly built radius, which is exceptionally well preserved, shows no signs whatever of having carried these structures.

The Odonata themselves cannot be brought into consideration,

since the fossil evidently lacks the essential discoidal cell, not to mention a nodus, which is almost certainly absent also. We are therefore driven back to consider the claims of the Protodonata.

The strongly built, probably coriaceous, border is already known in the Carboniferous genus *Meganeura*. The new fossil also resembles this genus in the manner in which M appears basally as a very weak vein, diverging gently from the strongly built R. The Protodonata, like the Odonata, are notable for the unbranched condition of Rs. Now, in *Meganeura*, there are, in the forewing, *two* radial sectors arising fairly close together, and running closely parallel for a considerable distance. If, owing to the narrowing of the wing, in the course of evolution,



Text-fig. 16.

Diagrams to show the structure of the radius and media in Protodonata: *a*, suggested ancestral condition, from which there can be derived:—*b*, the condition found in *Aëroplana mirabilis*, n.g. et sp., by fusion of the two radial sectors (Rs_1, Rs_2) near their bases; *c*, the condition found in the forewing of *Meganeura monyi* Brongn., with radial sectors still separate, but anterior branch of media (M_1) eliminated; and *d*, the condition in the hindwing of the same species, with the radial sectors eliminated but the media not reduced.

these two sectors were to fuse together, we might expect to get some such formation as we find in this new fossil, viz., a single Rs with two origins. In the hindwing of *Meganeura*, however, we find that Rs is entirely absent. But there is a peculiar anterior branch of M, which takes its place, and which branches dichotomously exactly in the same way that the corresponding branch of M in the hindwing of the new fossil does. All these

conditions, viz., that in the forewing of *Meganeura*, that in the hindwing of the same genus, and that in the hindwing of *Aëroplana*, can be easily obtained by reduction from the type of venation shown in Text-fig. 16, *a*, as may be seen from *b*, *c*, and *d* of the same Text-figure.

The rest of the media in *Meganeura* differs widely from that of *Aëroplana*, as is only to be expected when one considers the difference in the shape of the wings.

The cubitus in *Meganeura* (and probably in other Protodonata so far known) is simple. But it is a sinuously curved vein, resembling the Cu_2 of *Aëroplana* in its general course basally. Both genera have only a single main anal vein. But in *Meganeura*, as in other Protodonata, both Cu and A give off numerous descending branches, which are absent from *Aëroplana*.

We can only conclude that there is a certain amount of evidence of affinity between *Meganeura* and *Aëroplana*, though that evidence is by no means strong. The numerous points of difference are so evident that it will scarcely be necessary to enumerate them. There are, then, only two courses open to us: either we must place *Aëroplana* in the Order Protodonata, as a very highly specialised member, far removed from any known type of that Order; or we must make a new Order for it. In choosing the former alternative, while at the same time emphasising the unique character of the new fossil by placing it in a new Suborder, Aëroplanoptera, I have taken a course which will serve to indicate the degree of affinity of the fossil to the rest of the known Protodonata, while leaving it open to any other entomologist, if he considers this affinity insufficiently established, to raise the new Suborder to the status of an Order.

In conclusion, it seems to me quite possible that this extraordinary fossil may have held much the same position in the Order Protodonata, with respect to the *Meganeuridæ*, that the advanced *Agrionidæ* hold to-day, within the Order Odonata, with respect to such gigantic, archaic types as *Petalura*. If that be so, its existence in the Upper Triassic—at a time when, it is to be presumed, the rest of the Order had died out—need

occasion us no surprise, but is rather to be expected; just as we may expect that the more advanced Dragonflies of to-day will remain in existence, long after *Petalura* has become extinct.

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EXPLANATION OF PLATES XLIV.-XLV.

Plate xliv.

Fig.12.—*Aëroplana mirabilis*, n.g. et sp. Principal preserved portions of the wings; (×7).

Plate xlv.

Figs.13-14.—*Aëroplana mirabilis*, n.g. et sp. Restoration of fore- and hindwings; (×4). Fig.13, forewing; fig.14, hindwing.

1A, analis; C, costa; Cu_1, Cu_2, the two branches of the cubitus; M_1-M_7, the seven principal branches of the media; R_1, main stem of radius; Rs, radial sector; Sc, subcosta.

Postscript (*added July 12th, 1918*).—The following important changes of nomenclature have to be made:—

Mesopanorpa Tillyard, 1918 (Type, *M. wianamattensis* Tillyard, Upper Triassic of Glenlee, N.S.W., Mecoptera,) becomes *Mesopanorpodes*, n.n.; preoccupied by *Mesopanorpa* Handlirsch,

1908 (Type, *M. hartungi* Brauer, Redtenb. & Ganglb., Middle Jurassic of Ust Balei, Siberia). The family *Mesopanorpidæ* Tillyard becomes the family *Mesopanorpodidæ*, n.n. (*See* Tillyard, These Proceedings, 1917, xlii., Pt.4 (1918), pp.746-7).

Creagris Hagen, 1860 (Type, *C. plumbeus* Oliv., Neuroptera Planipennia, Europe) becomes *Creoleon*, n.n.; preoccupied by *Creagris* Nietner, 1857, a genus of Coleoptera, Fam. *Carabidæ*. I am indebted to Mr. T. G. Sloane for this discovery. (*See* Tillyard, These Proceedings, 1918, xliii., Pt.1, p.122). The tribe *Creagrini* becomes the tribe *Creoleontini*, n.n.—R.J.T.

Postscript (*added August 7th, 1918*).—The title of Part ii. of this series of Studies should be amended as follows:—

For "*Æschnidiopsis* (*Æschna*) *flindersiensis* (Woodward)", write "*Æschnidiopsis flindersiensis* (Woodward), [*Æschna*]." It was never intended to convey the suggestion that *Æschna* is a subgenus of *Æschnidiopsis*, and hence the order of the names must be altered as here shown.—R.J.T.

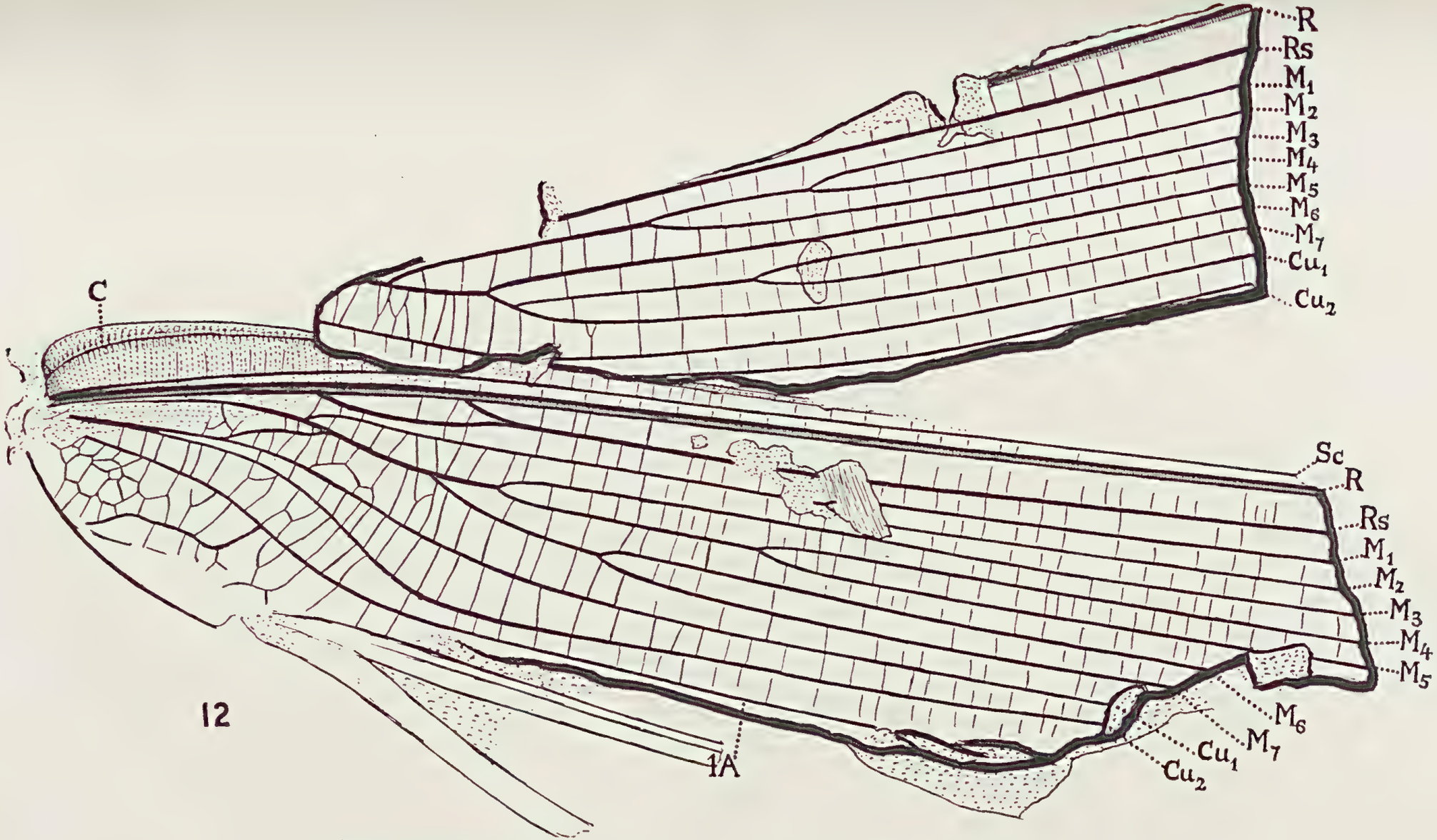
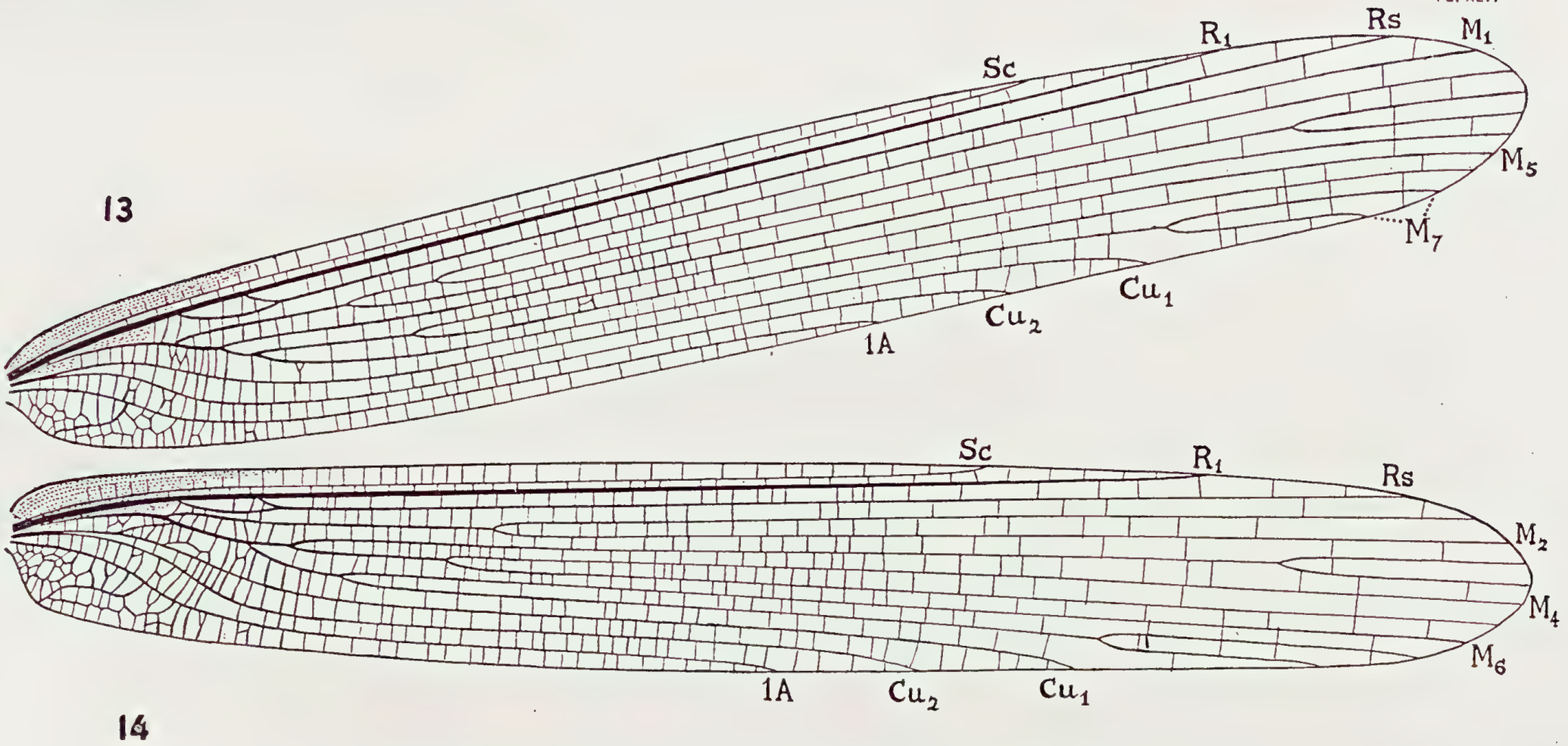


Fig. 12. *Aëroplana mirabilis*, n.g. et sp. Principal preserved portions of the wings; (× 7).



Figs. 13-14. *Aëroplana mirabilis*, n.g. et sp. Restoration of fore- and hindwings; (× 4).

[*From the Proceedings of the Linnean Society of New South Wales, 1918, Vol. xliii., Part 3, September 25th.*]

MESOZOIC INSECTS OF QUEENSLAND.

No. 4. Hemiptera Heteroptera: The Family *Dunstaniidæ*. With a Note on the Origin of the Heteroptera.

By R. J. Tillyard, M.A., D.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Plate lix.; and Text-figures 17-22).

In 1916, I described(3) the beautifully preserved wing of *Dunstania pulchra* Till., from the Upper Trias of Ipswich, Queensland, and placed it as the sole representative of a new family *Dunstaniidæ* within the Order Lepidoptera. This decision had the concurrence of Dr. A. Jefferis Turner, of Brisbane, and was based mainly upon the presence of eight longitudinal veins in the fossil, this being the number found in the hindwings of Frenate Lepidoptera.

While the description of this fossil was going to press, I happened to be on a visit to Brisbane. A day or two before I left, Mr. Dunstan showed me four other specimens bearing the label "*Dunstania*" in pencil; these had just been discovered at Ipswich. Two of them were broad wings resembling the type, and two were much longer and narrower wings. Thinking that these latter must be the forewings of the same insect as that whose hindwing I had assumed the type to be, I added the note on p.32 of the paper quoted above. However, when I received from Mr. Dunstan, later on, the complete collection of Ipswich Insects of which these wings formed a part, and had time to work at them in detail, I soon found that the two narrow wings did not belong to *Dunstania* at all; so that there remained only the two broad wings for study in connection with the original type. Neither of these is in anything like as good a state of preservation as the type is, and one of them is very poorly preserved indeed.

Meanwhile the publication of the original description had created considerable interest amongst entomologists, and discussion soon became rife as to its true affinities. In August, 1916, Mr. E. Meyrick, F.R.S., contributed a paper on the subject* (2), in which he argued strongly against the admission of *Dunstania* to the Order Lepidoptera, and suggested that its affinities might rather be with the Homoptera. He reasoned as follows :—"In order to appreciate the position, I looked up the record of *Palæontina oolitica* Butl., from the Jurassic, hitherto the oldest known Lepidopteron, ... ; I must express my opinion that there is little doubt it belongs to the *Hepialidæ*. . . . . Now it is clearly proved on structural grounds that the *Micropterygina* (the small group to which the *Hepialidæ* belong, otherwise termed Jugatæ) were the primitive form of the Lepidoptera, and the nature of *Palæontina* is in accord with this conclusion and confirmatory of it. Parenthetically, I take occasion to notice that Goss, Tillyard, and others are troubled as to what the early Lepidoptera can have fed upon, when flowering plants were not yet in existence, and honey was not available; it is a problem easy of solution, since the more primitive forms (including the *Hepialidæ*) have in general no proboscis or feeding apparatus, and, therefore, fed on nothing in the perfect state."

"With the evidence recounted above, *Dunstania*, if regarded as Lepidopterous, is violently discordant. As the hindwing possesses neither frenulum nor prominent basal angle of costa, it must be assumed that the forewing was furnished with a jugum; all existing Lepidoptera exhibit one or other of these structures. But all jugate Lepidoptera have the hindwing similar in neuration to the forewing, with at least 11 veins, whereas this wing seems to be of the modern 8-veined type, though conspicuously different from any known form, and in fact quite as highly specialised as any now existing. Finally, there is the apparently corneous margin round the costa and termen, which is altogether abnormal, no other Lepidoptera showing a

* See also "Nature," No. 2488, Vol. 99, Sept. 28th, 1916, p.75, where this paper is reviewed.

trace of it, and in my estimation a far more important systematic character than the two which the author lays stress on."

"It appears to me, then, that this specimen can only be regarded as Lepidopterous on the theory that it is a member of an entirely unknown line of development of that Order, which had attained a high degree of specialisation at a period far anterior to the earliest certainly Lepidopterous insect known, itself a lowly organised form; this cannot be termed impossible, but it involves a very great improbability. The alternative view that the resemblances are accidental and the insect not Lepidopterous seems to me, on the whole, less improbable."

"I cannot venture to express any positive opinion on its possible relation to other Orders, but I suggest that there are some points of resemblance to the Hemiptera-Homoptera, some species of which have a semi-Lepidopterous facies. The corneous margin of the wing, the central cell (usually, it is true, much larger), and approximate number of veins rising from it, and even the curious dark banding of the membrane alongside the veins, can all be paralleled in this group, which, moreover, is already known to have been in existence since the Carboniferous period."*

Mr. Meyrick's criticism led me to study intensely the various types of Lepidopterous wing-venation extant, about which I knew very little at the time that I first described the fossil. I very soon became convinced that *Dunstania* was not a Lepidopteron; but that conviction was not based, for the most part, on the argument set forth by Mr. Meyrick, which I regard as unsound in several important particulars.

Firstly, as regards *Palæontina*. The latest authority on the family to which this fossil belongs is Handlirsch (1), who gives a masterly treatment of this and allied fossils, with photographs and restorations of a number of types, in some of which the hindwing is complete enough to allow of definite proof that the *Palæontinidæ* were most certainly not *Hepialidæ*, as Meyrick avers, nor even Jugatæ of any kind, but definitely Frenatæ allied

* This is surely an error. No true Homoptera were known below the Lias, until I described *Mesojassus* from the Ipswich Trias, and, later on, two new genera from the Permian of Newcastle, N.S.W.

to the *Limacodidæ*. If Mr. Meyrick "turned up the record of *Palæontina oolitica*," how is it that he ignored Handlirsch's epochal work, which does not fit in with his own opinions?

I accept without any doubt whatever Handlirsch's proof that the *Palæontinidæ* were Frenate moths, though I take leave to doubt that they were as closely allied to the *Limacodidæ* as he imagined. The evidence of the hindwings, which are small, with only eight or nine veins, is conclusive on the point. Consequently, there is no absurdity in supposing that Frenate types might have existed also in the Lias, or in the Upper Trias of Australia. That being so, all this part of Mr. Meyrick's argument rests upon an unsound basis.

There is, therefore, no *a priori* reason why a Frenate moth, of a type *far removed* from those we know at the present day, might not also have been in existence in the Upper Trias at Ipswich, though I am quite willing to admit that it might not be a very probable supposition.

Secondly, as regards the "apparently corneous margin" round the costa and termen. In my description, I simply called this "a wide margin without pits," and added that "the external border, or *termen*, shows signs of a delicate transverse ribbing" which "extends also somewhat indistinctly round the apex on to the costa." I purposely refrained from suggesting that it was a corneous margin, as it seemed to me to be equally likely that it had been formed by the crushing down of the deep bases of insertion of a series of stiff and closely packed marginal hairs or bristles, such as one sees in many Diptera, for instance. There was no inherent improbability that such a margin might not be found on a strongly-built and hairy-winged, primitive Lepidopteron.

If, however, the margin be really corneous, then I admit that the character is of great importance, and definitely rules *Dunstania* out of the Lepidoptera. In the actual fossil, the appearance of this margin is certainly not such as to suggest a positive solution to this question, one way or another; but Mr. Meyrick, of course, had only my drawing to go upon.

Thirdly, I should like to reply to Mr. Meyrick's parenthetical

statement that the early ancestors of the Lepidoptera took no food in the imaginal condition. This argument defeats itself. For, if these insects took no food as imagines, then surely their descendants must have even more aborted mouth-parts than their ancestors, and thus they should all be either *Hepialidæ* or *Saturniidæ*! Surely the ancestors of those Lepidoptera that are, to-day, of the haustellate type were originally of the weak mandibulate type still preserved in *Micropteryx* and allies, and were, therefore, pollen-feeders and lappers-up of dew and rain-drops, as the great majority of the Planipennia, Mecoptera, Trichoptera and Diptera are to-day!

To my mind, the great argument against *Dunstania* being a Lepidopteron is simply this, that the venation, quite apart from the mere number of the veins, does not show any of the typical arrangements of that Order, whether Frenatæ or Jugatæ. As soon as I had sufficiently mastered the wing-venation of the Order, I became convinced of this, and definitely rejected my original placing of the fossil. It is part of the object of this paper to relate how the opinions of different entomologists, looking at the problem from different points of view, favoured the claims of various Orders to receive this fossil; but none, including myself, who had the type-specimen itself to study, succeeded in finding the true solution, which was at last given by the study of the new material.

Starting from Mr. Meyrick's suggestion that *Dunstania* might be Homopterous, I find that a number of correspondents entertained this idea, the strength of which lies, of course, in the interpretation of the margin of the wing as corneous. However, Mr. J. Edwards, of Cheltenham, England, an acknowledged expert upon this Order, wrote to Mr. Meyrick, and also to me, strongly opposing the idea, on the ground that he could see nothing in the fossil to indicate such a relationship. As the Homoptera are well represented in the Ipswich Trias by forms differing entirely from *Dunstania*, and as I was unable to establish a single venational character common to the two types, I soon abandoned any idea of relationships in this direction.

In correspondence, other entomologists discussed with me the

probable affinities of *Dunstania*, but their opinions were not published. In particular, I desire to mention Mr. Herbert Campion's share in the clearing up of the mystery. It was through his unfailing courtesy that I was kept in touch with the trend of opinion in England on the fossil, and from him I obtained valuable suggestions as to clues that were worth following out. One of the most interesting of these, originating with Mr. Durrant of the British Museum, and stated in publication by Dr. Bather, F.R.S., in the course of a short review of my paper in "Nature,"* was, that the venation of *Dunstania* might be compared with that of certain groups of Diptera, such as the *Psychodidæ*. At about the same time, Dr. C. J. Gahan, of the British Museum, had before him a small collection of insects from New Zealand, and suggested to Mr. Campion that the fossil should be compared with the Anthomyiid *Exsul singularis* Hutton, which it closely resembles in the shape and general appearance of the wing.

Acting on these suggestions, I put myself into communication with several New Zealand entomologists, in the endeavour to obtain material of *Exsul*. This, however, was not easy to get, as the fly is exceedingly rare, and regarded as a great prize. After a considerable time, I obtained two specimens, one from Mr. David Miller, Government Entomologist of New Zealand, and an expert Dipterologist, and another from Mr. G. V. Hudson, of Wellington. To both of these gentlemen I offer my cordial thanks for their generosity in sending me such valuable material.

While I could not admit any affinity between *Dunstania* and the *Psychodidæ*, I was impelled to study more closely its possible affinity with *Exsul*, in spite of some cardinal differences in the venational scheme, which would be hard to explain on any hypothesis. Believing that I had here, at last, a good solution of the problem, and wishing to give due credit to those to whom the suggestion was originally due, I wrote to "Nature,"† stating my adherence to the probable Dipterous nature of *Dunstania*. However, it was necessary to carry out a very detailed study of

* "Nature," No. 2441, Vol. 97, Aug. 10th, 1916, p.489.

† "Nature," No. 2488, Vol. 99, July 8th, 1917, p.373.

the fossil before anything could be published. Here I was helped and guided by a regular correspondence with Mr. Miller. He, like other entomologists, found in the supposed corneous border of the wing a stumbling-block to the acceptance of any theory of Dipterous affinity for the fossil. He also pointed out the remarkable difference between the structure of the costal vein in *Dunstania* and in *Exsul*, and finally declared his belief in the Homopterous nature of the fossil.

The only other possibility that occurred to me was, that *Dunstania* might be the wing of a large Oligoneurous Mayfly. The shape and venation of the wing made this likely; but I was unable to follow this line of research far, as I soon became convinced that the evident toughness and strength of build of the *Dunstania* wing could not possibly have belonged to the wings of any representative of the Order Plectoptera.

Here, then, after having reviewed possible affinities with four Orders, Lepidoptera, Diptera, Homoptera and Plectoptera, I abandoned the study of this puzzling fossil for a time, in the hope that a respite from the work might rid my mind of any preconceived notions, that were bound by now to be present, after so long a time spent in thinking over the problem, and might allow some new light to come in.

In the meanwhile, I had received from Mr. Dunstan the complete series of fossils found at Ipswich since my first paper had been published, and had been arranging these for study. For some months, I had put the new material of *Dunstania* by, as it was evidently in very poor preservation compared with the type, and I did not expect to get any new evidence from it. It was, however, from this new material that the solution of the problem came; and that solution was of such a nature that it could have scarcely been suggested as a possibility, on the evidence of the type alone.

The number of the type-specimen was 2*a*; the two wings of *Dunstania* received after the type had been described were numbered 107*a* and 147 respectively. In the present paper, I propose to give a complete description of the new material, together with a re-examination of the type in the light of the

new evidence, and an attempt at a complete restoration of the wing.

Specimen No.147 is in a very poor state of preservation, and represents practically the same area of the wing as is found in the type. It clearly belongs to a somewhat larger insect than the type; and, as the venation differs from that of the latter in some important respects, it will form the type of a new genus within the family *Dunstaniidæ*.

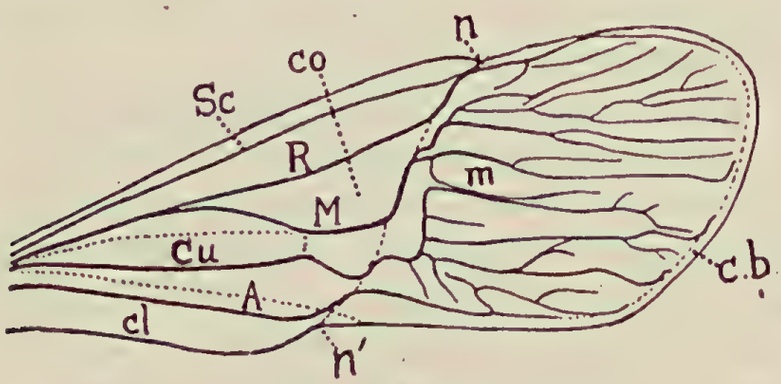
Specimen No.107*a* is in much better preservation than No. 147, but it is not so well preserved as the type. The apical part of the wing is missing, but the whole of what was taken to be the basal part in the type is fairly well preserved. On the other side of this there is preserved a large flattened area, with only traces of disconnected venation. On making a careful drawing of this, and trying to establish its connection with the rest of the wing, on which the venation is well preserved, it became at once apparent that this new fossil represented almost the whole (excluding the base and apex only) of a huge Heteropterous hemelytron, and that the supposed almost complete wings preserved in the type-specimen and in No.147 were, in reality, nothing more than the distal membranous half of the hemelytron, which is separated anteriorly from the basal half, or *corium*, by a strongly developed *node* upon the costa.

With this new and unexpected light upon the problem that had been exercising me for so long, the mystery of the affinities of *Dunstania* became cleared up in a moment. There cannot now be any doubt that these fossils are Heteropterous; the only question that remains for discussion is as to what, if any, recent or fossil families of Heteroptera show any affinity with them.

Before the fossils, including the type, can be correctly described in terms suitable to their new position, it will be necessary to examine them very carefully, with a view to trying to establish the homologies of their unique venation upon the Comstock-Needham system. This is a difficult task. I propose, therefore, to use the new names under which I shall describe the two new fossils at the end of this paper, in order to facilitate the discussion that must take place before those descriptions can be properly given.

Specimen No.107*a* is to be made the type of a new genus and species, *Dunstaniopsis triassica*, n.g. et sp., while specimen No. 147 will also be the type of a new genus and species, *Paradunstania affinis*, n.g. et sp. All these are evidently members of the same family, *Dunstaniidæ*, the venational differences being, at the most, only of generic value.

In discussing the venation of the *Dunstaniidæ*, we shall make use of the most complete specimen, *Dunstaniopsis triassica*, n.g. et sp., supplemented by the type of the family, *Dunstania pulchra* Till. It will be necessary to compare the venation on the corium of the former with the tracheation to be found on the same area of the hemelytra of recent Heteroptera. Unfortunately, few reliable figures of the latter are available. I have selected as the most suitable for our purpose the excellent figure of the tracheation of the nymphal forewing of *Syromastes* (family *Coreidæ*) given by Handlirsch (1, Atlas, Pl. vii., fig.3). It is not necessary to figure the corresponding venation in the imago, as it only differs from that of the nymph in the greater differentiation between corium and membrane, the dividing line becoming a complete whole, and effectually concealing the connections between the veins on the corium and those on the membrane. Consequently, such an archaic type as *Dunstaniopsis* is more closely comparable with the tracheation of the nymphal wing of *Syromastes* than with the venation of the imaginal wing.

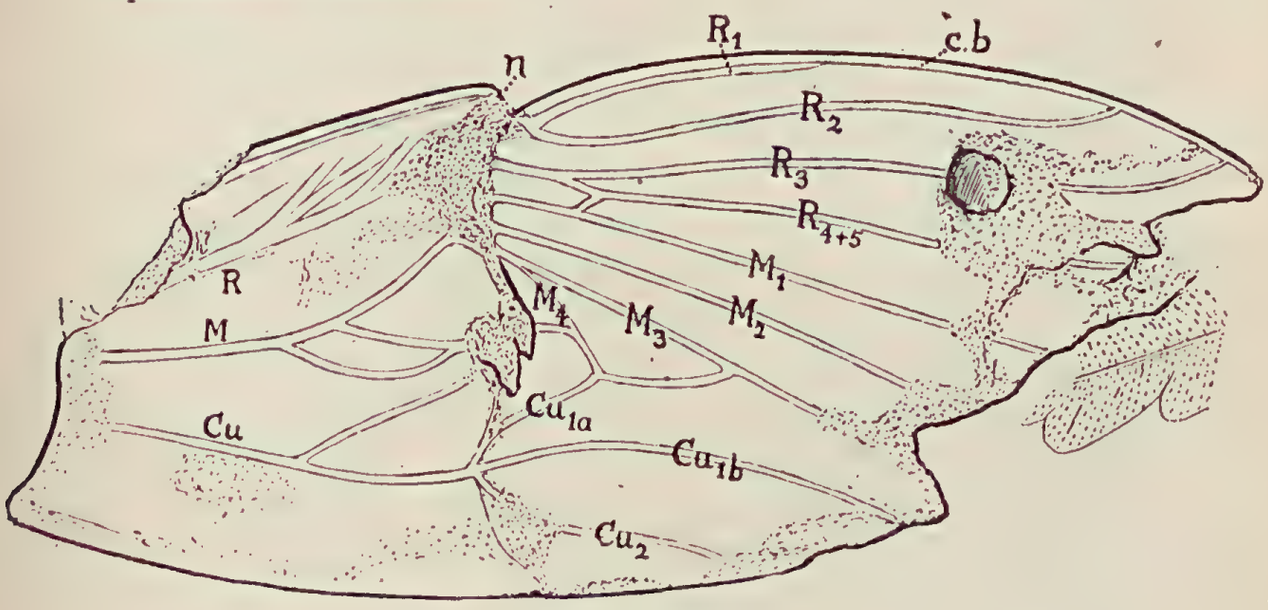


Text-fig. 17.

Tracheation of forewing of nymph of *Syromastes* sp.; (×8). After Handlirsch. For lettering, see p.592.

Text-fig.17 shows the tracheation of the nymphal wing in *Syromastes*. The wing consists of a hard coriaceous basal half,

called the *corium* (*co*), and a softer membranous distal half, called the *membrane* (*m*). These are separated by the *dividing line*, running somewhat obliquely across the wing from the *node* (*n*) on the costa to the *antinode* (*n'*) on the dorsum. Posterior to the corium is a narrow projecting anal area, known as the *clavus* (*cl*). Around the membrane is a complete *coriaceous border* (*c.b.*), such as we have already noticed very prominently in the type-specimen of *Dunstania*.



Text-fig. 18.

Hemelytron of *Dunstaniopsis triassica*, n.g. et sp.; (×2·8). Upper Triassic, Ipswich, Q. For lettering, see p.592.

Turning next to *Dunstaniopsis* (Text-fig. 18) we see that the node is more prominent, but that the dividing line is, on the whole, not so clearly marked, and its course is far more irregular. This line also runs more transversely across the wing in *Dunstaniopsis* than in *Syromastes*; but, in many recent Heteroptera, especially in the family *Pentatomidæ*, it takes a similar transverse course, though much straighter than in *Dunstaniopsis*. A further point of difference is that no true claval area can be seen in *Dunstaniopsis*. But, as the extreme base of the wing is not preserved, there may well have been a short clavus present on the lost part.

Turning next to the venation, we notice that, in *Syromastes*, the corium is crossed by four longitudinal veins, not counting the analis, which borders the clavus anteriorly. By reference

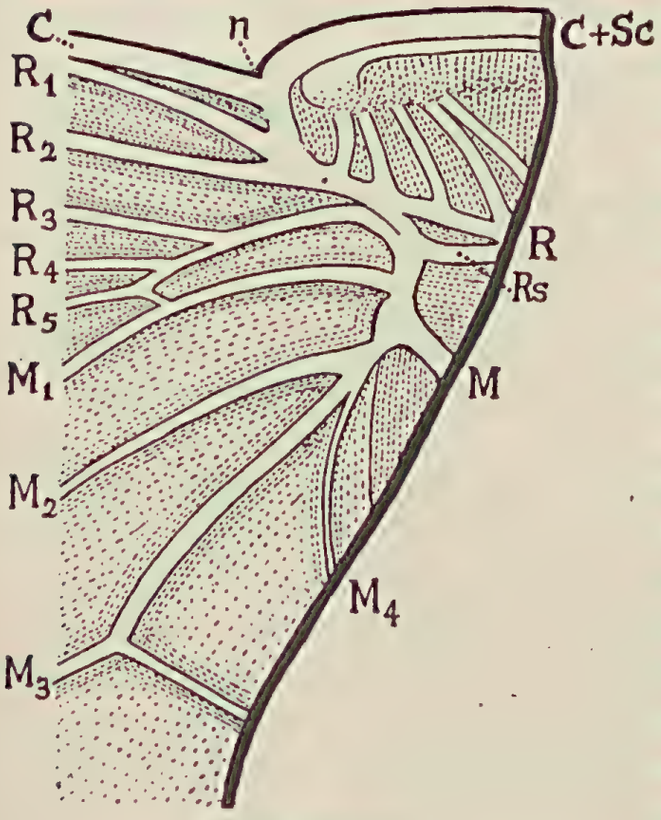
to the precedent tracheation, these veins are shown to be the subcosta, radius, media, and cubitus respectively. As in most Heteroptera, the subcostal trachea lies close up to the costal border; in the imago, the subcostal vein becomes more or less fused with this border. The radius and media are fused for some distance from their bases, and then diverge gradually at an acute angle. The cubitus is a separate vein, lying about half-way between the media and analis.

Having made the above comparison with *Syromastes*, it now becomes an easy task to name the radius, media, and cubitus in the corium of *Dunstaniopsis*. This is shown in Text-fig. 18. Owing, however, to the bad state of preservation, in this fossil, of the dividing line between corium and membrane, we cannot proceed to name the numerous veins in the latter area with any certainty. Here, however, we may fall back upon the type-specimen of *Dunstania*, in which there is just enough of the corium preserved to enable us to make the necessary connections.

In my original description of *Dunstania*, I paid little attention to this part of the wing, believing it to represent only a small flattened-out portion of the thorax of the insect. I now give, in Text-fig. 19, a careful drawing of the region of the node and dividing line in this fossil. From the figure of *Dunstaniopsis*, it will be seen that R and M, after diverging from one another in the middle of the corium, again begin to converge, and are then unfortunately lost in a break in the rock-surface. In *Dunstania*, however, we are able to pick up these two veins as they approach the dividing line. R is seen to be just dividing into R_1 and Rs, while M converges towards the latter as a stout vein from below. Sc is fused with the costa, as in *Dunstaniopsis*. Between Sc and R there are a number of oblique ribs, half fused into the corium; these can also be seen in *Dunstaniopsis*, further basad along the same area.

Just before the level of the node, Rs turns upwards, and partially fuses with R_1. From the combined stem thus formed, three branches pass out into the membrane, viz., R_1, R_2, and R_{3-5}. Of these, R_1 is a short vein lying close alongside the costal margin, and supporting it from below; it ends up at about one-

third of the length of the membrane, upon the costal margin. The second branch, R_2, is a longer, gracefully curved vein, running below R_1 and parallel to the costal margin for most of its length, and finally curving up to meet the margin at about two-thirds of the length of the membrane. The last branch, R_{3-5}, gives off R_3, close to its base, and immediately after divides into R_4 and R_5. R_3 passes in a gentle curve beneath R_2, and ends up just above the apex of the wing. R_4 and R_5 meet again (in *Dunstania* only) beyond the middle of the membrane, and from there on continue straight to the termen as a single vein R_{4+5}. In *Dunstaniopsis*, R_{4+5} is a single unbroken vein from its origin to its termination.



Text-fig. 19.*

Returning to the corium of *Dunstania* (Text-fig. 19 and Plate lix., fig. 15), we can pick up M converging towards R as it approaches the membrane. On the dividing line, it is connected with R by a short, stout cross-vein, forming portion of the dividing line itself. From the swollen root of M upon the dividing line, two branches pass out into the membrane. Of these, the upper, M_1, arches gently upwards, so as to approach close to R_{3-5}, and is connected with R_5, just distad from its origin, by a short cross-vein. Thence onward, M_1 runs with a slight double-curving to the termen. The lower branch, M_{2+3}, almost

* Region of node and dividing line in hemelytron of *Dunstania pulchra* Till., showing the small anterior portion of the corium preserved in the fossil; (×7·5). Upper Triassic, Ipswich, Q.

immediately divides into two; of these, the upper, M_2, runs to the termen on a similar course to that of M_1, but well below it; while the lower branch, M_3, diverges from M_2 for some distance, until it gives off a backwardly descending vein, whose destination cannot be followed out in *Dunstania*; at this point, M_3 is bent at a very oblique angle, and passes on probably to near the tornus of the wing.

From the base of M_3, in *Dunstania*, a very weakly indicated vein, M_4, can be made out, passing downwards, about midway between M_3 and the dividing line; it can be seen to be converging towards the cross-vein mentioned in the preceding paragraph; but the fracture of the rock hides its further course from our view.

In order to follow out the further structure of the wing, posteriad to the region of M, we must now turn again to *Dunstaniopsis* (Text-fig.18), in which most of this part of the wing is fairly well preserved. In this genus, we can easily pick up the cubitus, running with a gentle curve upon the corium, well below M. In *Syromastes*, we see that M and Cu are connected by a short cross-vein, not far from the dividing line. In *Dunstaniopsis*, Cu gives off an oblique anterior branch, which approaches closely to two oblique posterior branches given off by M at about the same level; these two branches of M unite close to the dividing line, at a point where the branch from Cu lies very close below them. Here there is a break in the rock-surface; but we can pick up, on the other side of the break, a single weak vein curving into M_4. This is evidently the prolongation of the united branches from M and Cu.

Turning now to the main stem of Cu, we can follow it, in *Dunstaniopsis*, up to the dividing line between corium and membrane, where it gives off an oblique anterior branch, Cu_{1a}; this branch meets M_4, the weak vein already mentioned as descending from the base of M_3. At the angle formed by these two, which is almost a right angle in *Dunstaniopsis*, a third vein comes in from the membrane; following this distad, we see that it arises from M_3, which, in this genus, is a straight vein running to near the tornus of the wing.

We can now complete this part of the wing in *Dunstania*. The descending vein from M_3 must be the homologue of the corresponding vein in *Dunstaniopsis*; the only difference is in the angle of departure from M_3. On this difference, as well as upon its more numerous and slightly more divergent veins, we see at once that *Dunstania* had a broader and shorter membrane than *Dunstaniopsis*.

Following the main stem of Cu, which I call Cu_{1b}, across the dividing line in *Dunstaniopsis*, we see that it continues in a gentle curve, until it ends up on the dorsum of the wing, not far from the tornus. Below Cu_{1b}, another branch of Cu, Cu_2, arises on the dividing line, and passes into the membrane as a curved vein running to the dorsum below Cu_1.

The dividing line hereabouts is not well preserved, but its ending up on the dorsum can be just made out. The division between corium and membrane is clearly noticeable in the fossil on account of the difference between the colour of the rock and the fossil itself. The former is a dark grey; the latter a pale brown. The whole of the corium is coloured pale brown, and is flat and smooth. The membrane, on the other hand, is varicoloured, showing pale veins bordered by narrow bands of dark brown pigment, and, between these, areas of the darker rock-colour on those parts where no veins are present. Also, the membrane is lightly pitted all over, whereas the corium is quite smooth in this genus.

Sufficient will now have been said to make it abundantly clear that we have, in *Dunstania* and its allied genera, a primitive type of Heteropteron, of large size, and very probably of amphibiotic habits. From recent Heteroptera, such as the *Lygæidæ* and *Pyrrhocoridæ*, in which some of the venation is still preserved upon the corium, the *Dunstaniidæ* differ in the incompleteness and tortuosity of the dividing line between corium and membrane; and they show us how the anterior portion of this dividing line has been evolved, apparently in a most complicated manner, from a series of cross-veins and branches of main-veins linking up at different angles. The process by which the straight division between corium and membrane, found in most recent

Heteroptera, has been evolved from the stage seen in the *Dunstaniidæ*, is simply one of reduction and alignment of parts. When it is completed, as in recent *Pentatomidæ*, the clue to the venation of the membrane would be quite lost, were it not for the preservation of the tracheæ in the nymphal wing. I have not been able to find a single existing type of Heteropteron in which this venation is at all closely comparable with that of *Dunstania*. In the aquatic forms, especially, there does not seem to be any clue at all. Judging chiefly by the shape of the wing, and the condition of the venation of the corium, I am inclined to regard the *Coreidæ*, *Lygæidæ*, and *Pyrrhocoridæ* as the nearest relatives of the *Dunstaniidæ* at the present day. These three families, and no doubt also the *Pentatomidæ*, may well lie almost in a direct line of descent from the *Dunstaniidæ*. We should have to suppose, in restoring the latter, that the development of the scutellum had advanced very little beyond a normal size; and consequently, that the clavus, which, in the position of rest, borders the scutellum, was also very short. As no anal vein or clavus can be seen in the preserved portion of the hemelytron of *Dunstaniopsis*, this was almost certainly the case.

In Plate lix., fig.15, I offer a restoration of the complete hemelytron of *Dunstania pulchra* Till., based upon the preserved portions of the type and of *Dunstaniopsis triassica*. The poorly preserved *Paradunstania affinis* has not been brought into the discussion at all, and its only use in the restoration is to indicate the course of the wing-border below the tornus.

It now remains for me to revise my original definition of the family *Dunstaniidæ* in the light of our new knowledge, and to give definitions of the type-genus, and of the two new genera here proposed, and descriptions of the new species.

Order **HEMIPTERA.**

Suborder **Heteroptera.**

Family DUNSTANIIDÆ.

Large bugs, with hemelytra more than 30 mm. long. Hemelytron suboval, about half as wide as long, the corium either smooth or lightly pitted (hairy), the membrane pitted (hairy).

Veins present on the corium are R, M, and Cu; no clavus visible in the preserved portion, but the base of the wing is incomplete posteriorly in all known specimens. Sc fused with costal margin. Costa broken between corium and membrane by a strongly developed node. Dividing line between corium and membrane crosses the wing from node to antinode in a very irregular manner, being formed anteriorly by short cross-veins and portions of main veins, posteriorly by a sinuous line not made up of veins. On the membrane there are either eight or nine longitudinal veins, of which either three or four arise from R, three from M, and two from Cu; these veins runs distad in a slightly diverging manner, R_3 ending up at or near the apex, and Cu_1 at or near the tornus. From M_3 a downward and backwardly running branch passes to the dividing line, where it meets the intersection of M_4 and Cu_{1a}. Few cross-veins present on membrane. Veins of the membrane pale, generally bordered on either side by a band of dark brown pigment. A fairly broad border without pits, and probably coriaceous, runs completely round the membrane.

Horizon, Upper Trias of Ipswich, Queensland.

The genera comprised in this family are *Dunstania* Till., *Dunstaniopsis*, n.g., and *Paradunstania*, n.g.

Key to the known genera of *Dunstaniidæ*.

	M_1 connected with the lowest branch of R by a short cross-vein, not far distad from the dividing line	1.
	No cross-vein present at this level between M_1 and lowest branch of R	*Paradunstania*, n.g.
1.	Four branches of R crossing the membrane, viz., R_2 to R_5; R_4 and R_5 unite a little beyond half-way, forming a closed cell	*Dunstania* Till.
1.	Three branches of R crossing the membrane, viz, R_2, R_3, and R_{4+5}; the last a single straight vein connected with M_1 near its origin	*Dunstaniopsis*, n.g.

Genus Dunstania Tillyard.

(Plate lix., fig.15, and Text-fig.19).

Membrane and a very small portion only of the corium preserved. Preserved portion of corium distinctly pitted all over. Membrane about as broad as long, the apex prominent but grace-

fully rounded. Node exceedingly prominent. R_1 a weak vein fused with costal margin from below node up to about one-third the length of the membrane. R_2 ending well before the apex, R_3 at the apex itself. Between R and M, at the base of the membrane, a closed cell is formed, bounded by the dividing line basally, by R_{3-5} anteriorly, by M_1 posteriorly, and by a short cross-vein connecting these two veins distally. Distally from this cell a second closed cell is formed between R_4 and R_5, these two veins at first diverging, and then converging to meet again at a point beyond the middle of the membrane. M_2 and M_3 united distally for a short distance upon the membrane. The backwardly projecting branch from M_3 comes off almost at right angles from the main stem. (Rest of hemelytron missing).

Genotype, *Dunstania pulchra* Till., (3, p.32, and Plate iii., fig.6).

Genus DUNSTANIOPSIS, n.g. (Text-fig.18).

Hemelytron completely preserved except for the extreme base of the corium (including the clavus, if present) and the apical portion of the membrane. A longer wing than that of *Dunstania*, and narrower in proportion. Differs from *Dunstania* as follows:—Corium smooth, membrane lightly pitted all over. Coriaceous border narrower and less defined; node somewhat less prominent. R_{4+5} a single straight vein, and hence no closed cell formed between R_4 and R_5. The basal cell completed by the presence of the short cross-vein between M_1 and lowest branch of R is present, but is much shorter than in *Dunstania*. The backwardly projecting branch from M_3 to the junction of M_4 and Cu_{1a} comes off from the main stem at an angle of about 30°, and runs almost parallel to the posterior border below it. On the corium, M curves upward distally, converging towards R, and giving off posteriorly two branches which unite further distad and then meet an anterior branch given off from Cu; this latter vein divides at the dividing line into three branches, Cu_{1a}, Cu_{1b}, and Cu_2, of which the first runs to the intersection of M_4 and the backward branch from M_3. Cu_{1b} ends up at or near the tornus.

Genotype, *Dunstaniopsis triassica*, n.sp.

DUNSTANIOPSIS TRIASSICA, n.sp. (Text-fig. 18).

Greatest length of fragment, 31·5 mm.; breadth across the dividing line, 15·5 mm Estimated total length of hemelytron, 40 mm.

The specimen is only moderately preserved, and would appear to have been much torn distally before it became fossilised, since a part of a frond of *Thinnfeldia*, lying upon the same rock-surface, projects well into the gap where the missing distal portion ought to be, and is embraced on one side by the projecting torn costa, without appearing to overlie the wing in any way. Also the beautiful pattern of brown pigmentation bordering the veins of the membrane, though it can be seen to be present, is not by any means so well preserved as in *Dunstania*. The corium appears to have been hard, and is fairly well preserved; the veins lying upon it are not so distinct as those upon the membrane.

The venational characters being considered as of either family or generic importance, they will be found in full in the definitions given above.

Type, Specimen No. 107*a*, in the Queensland Geological Survey Collection.

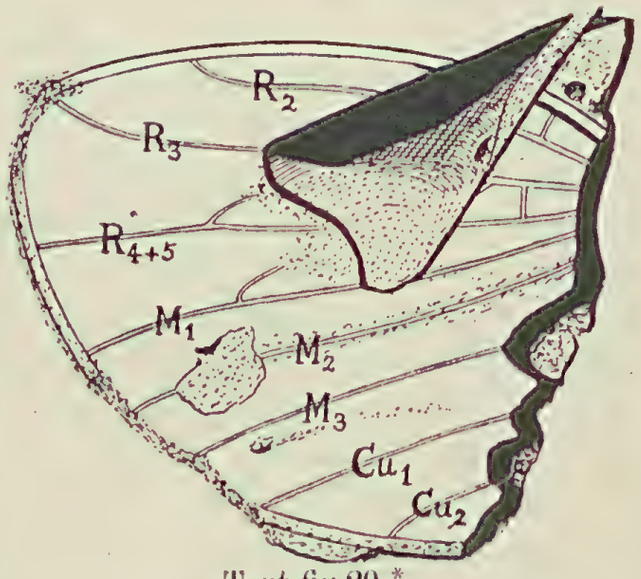
Genus PARADUNSTANIA, n.g. (Text-fig. 20).

Portion of membrane only preserved, and in very poor condition. Apparently a hemelytron of somewhat larger size than that of *Dunstania*. No cross-veins basally between M_1 and lowest branch of R. Cross-veins developed not far from dividing line between R_1 and R_2, and also between R_3 and R_{4+5}. This last vein receives a curved branch-vein from above, at about the same point as where, in *Dunstania*, R_4 and R_5 unite distally; but a break in the rock-surface prevents us from determining whether this branch is really R_4 or not. At about the same level, M_1 receives a curving branch from above; this branch appears to come from R_{4+5}, but its origin is not determinable with certainty. Rest of venation similar to that of *Dunstania*.

Genotype, *Paradunstania affinis*, n.sp.

PARADUNSTANIA AFFINIS, n.sp. (Text-fig.20).

Greatest length of fragment, 17 mm.; greatest breadth, 14·5 mm. A very poorly preserved specimen, with very little trace of the brown pigmentation bordering the veins. A large and deep triangular break has cut out a considerable portion of the courses of all the branches of R; the rest of the veins present can be traced out by the use of careful lighting.



Text-fig.20.*

This specimen appears to represent a hemelytron intermediate in size between that of *Dunstania pulchra* Till., and the much larger hemelytron of *Dunstaniopsis triassica*, n.g. et sp. In shape, also, it was probably intermediate between these two.

Type, Specimen No.147, in the Queensland Geological Survey Collection.

Note on the Origin of the Heteroptera.

In dealing with the phylogeny of the Order Hemiptera, Handlirsch (1, pp.1244-1249) rightly insists upon the clear-cut dichotomy between the two Suborders Heteroptera and Homoptera. Neither of these two Suborders can be derived from the other; for, on the one hand, the Homoptera have preserved the more primitive wing-form and venation, while, on the other, the Heteroptera have preserved the more archaic form of the head and antennæ. As the direct ancestors of both these recent Suborders, Handlirsch indicates some known Hemipterous fossils of the Upper Permian and Lias of the Northern Hemisphere, which he places in a distinct Order, Palæohemiptera, on the ground that it is not possible to demonstrate that they are definitely either Heteropterous or Homopterous. The Palæohemiptera he

* *Paradunstania affinis*, n.g. et sp.; (×2·8). Upper Triassic, Ipswich, Q.

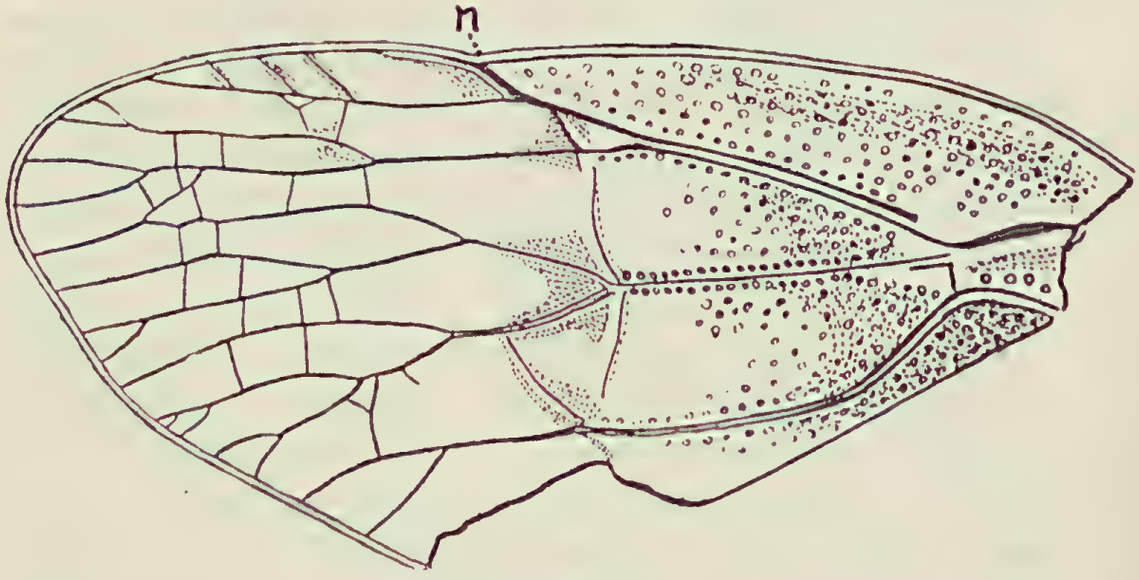
would, in turn, derive from the Lower Permian fossil genus *Eugereon*, which he places in a third Order, Protohemiptera.

Had it not been for the preservation of its mouth-parts, which form a primitive elongated sucking beak, *Eugereon* would never have been considered to have any relationship whatever with the Hemiptera. It was a huge insect, with primitive densely veined wings that were held out away from the body; the prothorax had lateral expansions suggestive of rudimentary wings, as in the case of some of the Carboniferous fossils. Apart from the dense venation, it is not possible to establish any close relationship between the venational plan of *Eugereon* and that of primitive Hemiptera; although it might be admitted that such a connection may possibly have actually taken place in the course of evolution, between *Eugereon* and the most densely veined types of *Fulgoridæ*, if the venation of the former had undergone a great deal of reduction and fusion of parts. That being so, it seems to me that the Protohemiptera are best regarded as a separate Order lying right off the main line of descent of the Hemiptera proper; the connection between the two being only establishable through a lost Carboniferous ancestor common to both.

The Palæohemiptera, on the other hand, are so obviously Hemiptera, that there seems to be no point at all in erecting a separate Order to contain them. Most of the Liassic fossils known are, in fact, definitely placed within the Homoptera by Handlirsch; and it is quite evident that they rightly belong there. Only the genus *Dysmorphoptila* Brodie, is retained within the Palæohemiptera; and, as this is probably a fragment, we may disregard it. Turning to the Permian fossils, we find two beautifully preserved wings, *Scytinoptera kokeni* Handl., and *Prosbole hirsuta* Koken, which are placed together in the Order Palæohemiptera. The former, I would regard definitely as an Homopteron; the latter most certainly combines the wing-characters of both Heteroptera and Homoptera, and could not well be placed in either Suborder without disregarding its evident affinity to the other. I propose, therefore, to sink Handlirsch's Order Palæohemiptera to the status of a Suborder within the

Order Hemiptera, this Suborder representing the original main stem of the Order, while the Heteroptera and Homoptera represent two distinct branches evolved from it.

Let us now compare *Prosbole* (Text-fig.21) with the restored wing of *Dunstania*, with a view to the establishment of a more complete phylogeny of the Heteroptera.



Text-fig.21.

Prosbole hirsuta Koken, hemelytron, after Handlirsch; (×2·1).
Upper Permian, Kama River, Russia; *n*, node.

We notice, at once, that *Dunstania* is much more definitely Heteropterous, in that it shows the distinction between corium and membrane much more plainly than *Prosbole* does. Moreover, the corium of *Prosbole* is strongly pitted, while the membrane is smooth. In *Dunstania*, both are strongly pitted, while, in *Dunstaniopsis*, the corium is smooth and the membrane pitted. If, then, these genera had a common ancestor, it must have had a wing pitted all over, such as we find still preserved in many Homoptera. In most recent forms, the pits are swollen into tubercles, and no longer carry hairs; but there can be little doubt, from the nature of the pits in *Dunstania*, that, originally at any rate, they were the bases of insertion of macrotrichia. As we have already seen in the Protomecoptera, the macrotrichia were originally carried upon a dense meshwork of veinlets all over the wing. If, then, the wings of the Protohemiptera were also hairy, we are led to suggest that the true Hemiptera

diverged from them by a reduction of the original meshwork, in the course of which the pits, or bases of insertion for the macrotrichia, became seated upon the membrane of the wing; just as, in the Lepidoptera, the scales have appeared in a similar manner.

The original pitted wing of the true Hemiptera may be considered to have given origin directly to the various wing-types still extant amongst the older families of recent Homoptera; the main developments in this latter Suborder are not to be found in the wing at all, but in the specialisation of the head and antennæ, and in the development of the power of leaping. In this connection, we should bear in mind that a number of Homoptera, especially in the *Cicadidæ*, still show the dividing line between corium and membrane.

We have now to consider the origin of the Heteroptera. For this, we cannot take *Prosbole* itself as a starting point; but we must go back a little way beyond this type, and assume a closely similar ancestral form with a wing pitted all over. Keeping the *main scheme* of venation unaltered, we may now see the origin of the Heteroptera in a form in which the tendency of evolution in the basal half of the wing was towards *suppression* of the venation and hardening of the wing-membrane (with or without loss of the pits); while, in the distal half of the wing, the cross-veins of dense Fulgorid-like venation still preserved in *Prosbole* become obsolete, and the remaining venation becomes greatly altered, in correlation with the differentiation of the dividing line between corium and membrane.

I think that a very little consideration, aided by a comparison of the figures of *Prosbole* and *Dunstania* here given, must convince us that *Dunstania* represents a very typical immediate derivative from the hypothetical ancestor of *Prosbole*, from which we started in the preceding paragraph, along the lines there indicated as leading directly to the Heteropterous type. That is to say, *Dunstania*, though not directly derivable from *Prosbole*, is nevertheless closely related to it; but, while *Prosbole* itself cannot be accepted as having advanced along the line of the true Heteroptera, and must, therefore, be kept in a separate Suborder Palæohemiptera, *Dunstania*, on the other hand, has

advanced far enough to be considered a definite Heteropteron of a primitive type.

Let us now consider the very interesting question of the evolution of the dividing line between corium and membrane in the Suborder Heteroptera. *Dunstania* shows us this line in an exceedingly primitive condition. From it, we see that its anterior portion was originally composed of either branches of main veins, or cross-veins. But, as the main veins are all proceeding more or less distad, it is, therefore, inevitable that these various parts should meet at different angles, as we see so definitely shown in *Dunstania*.

The parts of the dividing line may be shown as follows, starting from the node or costal end (see Plate lix., fig.15, and Text-figs.18-19):—

A. Anterior Division, formed from cross-veins and branches of main veins:

1. The *node*, formed from the fused C and Sc.
2. Radial portion, formed from short parts of R_1 and R_2, partially fused together.
3. A short cross-vein connecting the radial portion with the median portion.
4. Median portion, consisting of a swollen root on M, from which the three branches of M are given off.

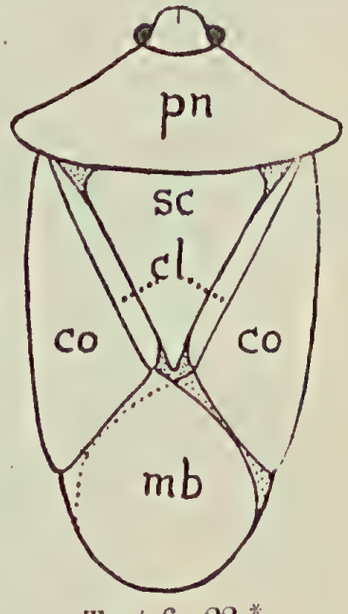
B. Posterior Division, consisting of a sinuous line crossing the wing more or less transversely, and not carrying either cross-veins or parts of main veins:

5. Medio-cubital portion, from the swollen root of M to Cu; the curvature of this part is concave to the corium.
6. Cubito-anal portion, from Cu to the antinode; the curvature of this part is slightly convex to the corium.

In the evolution of such a type as a recent Lygæid or Pentatomid Bug, all these diverse parts have to become aligned and fused into one harmonious whole. Probably a careful study of existing types amongst the Heteroptera would reveal many traces of the method by which this change has been brought about.

The other point of outstanding interest in the evolution of the Heteropterous hemelytron is the development of the clavus,

which is correlated with the growth of the scutellum. We are bound to assume that, in the original Hemiptera, the scutellum was of more normal size than it now is; and, consequently, the wings were not so completely folded over one another distally as they now are. In fact, we have to start from the normal type of scutellum and the roof-like position of holding the wings, still to be found in many Homoptera of the present day. From this, a gradual enlargement of the scutellum, together with a close folding-down of the wings upon one another, leads us to the condition found in recent Heteroptera. Here the dividing line marks the limit of the portions of the wing that are folded upon one another; while the anal area, or clavus, borders the two posterior sides of the large triangular scutellum. Thus we have to correlate the length of the clavus with the size of the scutellum, the tendency being towards enlargement as evolution progresses. Since, in *Dunstaniopsis*, there is no trace of a clavus in the preserved part of the wing, and the same is true of *Prosbole*, we have to conclude that both these forms had only a small or moderate-sized scutellum, bordered by a correspondingly short clavus, or even, perhaps, by scarcely any claval area at all.



Text-fig. 22.*

As soon as the overlapping of the two distal parts of the wing, or membranes, has been brought about, it will be clear that these two parts will in future act (while the insect is at rest) as one only; whereas the coria of the two wings remain separate. There will, therefore, be little tendency towards the thickening of the membrane at all, and the "heteroptery" might be expected to advance more quickly than ever. The line of evolution would then culminate in forms having a thick corium, from which all traces

* Diagram of a Shield-bug, family *Pentatomidæ*, to show the five parts of the shield, viz., 1, the pronotum, *pn*; 2, the scutellum, *sc*; 3 and 4, the right and left coria, *co*; and 5, the two completely overlapping membranes, *mb*. The clavus, *cl*, borders the scutellum on either side.

of venation had been eliminated, and a thin membrane, in which the veins were arranged more or less parallel to one another and to the wing-border. Probably the highest point reached by this line of evolution to-day is to be seen in the dominant family *Pentatomidæ*, in which the shield-shaped or "cut-into-five" appearance of the insect becomes perfected, and is often enhanced by bizarre sculpture and brilliant colouration. Text-fig. 22 shows the outline of such an insect, with the five separate areas of the shield-design named.

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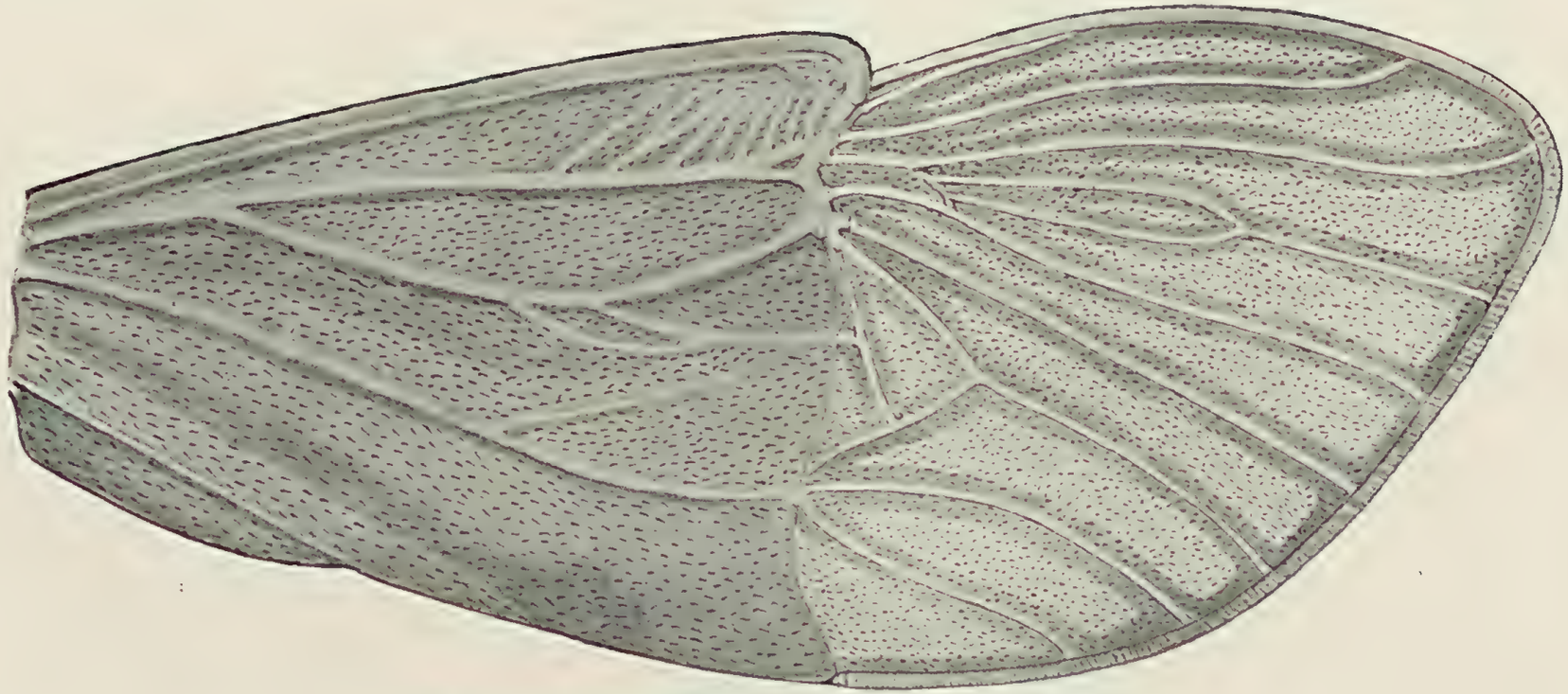
EXPLANATION OF PLATE LIX.

Fig. 15.—Restoration of right hemelytron (forewing) of *Dunstania pulchra* Till., based upon the preserved portions of this fossil and of the allied *Dunstaniopsis triassica*, n.g. et sp.; (×5).

Lettering of Text-figures.

A, analis—C, costa—*c.b.*, coriaceous border—*cl*, clavus—*co*, corium—Cu, cubitus; Cu_{1a}, Cu_{1b}, Cu_2, its branches on the membrane—*m* or *mb*, membrane—M, media; M_1 to M_4, its branches on the membrane—*n*, node—*n'*, antinode—*pn*, pronotum—R, radius; R_1 to R_5, its branches on the membrane—Rs, radial sector—*sc*, scutellum—Sc, subcosta.



Restoration of right hemelytron (forewing) of *Dunstania pulchra* Till.

[*From the Proceedings of the Linnean Society of New South Wales, 1919, Vol. xliv., Part 1, May 29th.*]

MESOZOIC INSECTS OF QUEENSLAND.

No.5. Mecoptera, the new Order Paratrichoptera, and additions to Planipennia.

By R. J. Tillyard, M.A., D.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Text-figs. 23-28).

The fossils dealt with in this Part belong to the *third* collection of fossil Insects from the Upper Trias of Ipswich, Queensland, already referred to in No.3 of this series (4, p.417). In No.1 of this series(3) I dealt with the Planipennia, Trichoptera, and Protomecoptera from the *second* collection made by Mr. Dunstan (if we count in also the Simmonds collection, this would be the *third* collection made at Ipswich altogether). As the new insects throw much light upon the important Orders which they represent, it seemed best to deal with them as soon as possible, even though many other fossils from the earlier collections still remain undescribed.

The material dealt with consists of two Mecoptera, two Trichopterous-like insects, one Planipennian, and one wing of uncertain position within the Panorpoid Orders. The Mecoptera are not well preserved, and one is too fragmentary to merit a name. The Planipennian, though not a complete wing, is one of the most beautifully preserved and most important of the new types found at Ipswich. One of the Trichopterous-like fossils is an almost complete and very beautifully preserved forewing, showing some quite new and unexpected characters, which prove that the wings from the Ipswich Trias which we have hitherto regarded as true Trichoptera, do not really belong to that Order, but to a distinct group separated from it by two very important characters. My original intention was to place these within a

new Suborder Paratrichoptera of the Order Trichoptera. But this has been found to be quite incompatible with more recent evidence forthcoming from a fine new fossil wing found in the Upper Coal Measures of Newcastle, which I shall shortly deal with in a separate paper. It is therefore necessary, in this paper, to propose the recognition of a new Order Paratrichoptera for the four genera of Trichopterous-like wings so far found at Ipswich, and to explain carefully the essential differences between the two types of venation found in the Trichoptera on the one hand and the new Order on the other.

Order **MECOPTERA**.

Family STEREOCHORISTIDÆ, fam.nov.

Small Scorpion-flies having the radial sector four-branched, the media six-branched. Cubital fork placed close to base; Cu_1 united to M by an oblique vein, the posterior arculus (*pa*), which appears to be itself a true branch of M; the vein formed by the union of *pa* with Cu_1 continues as a straight, strong, convex vein for some distance, and then stops suddenly short, dividing into two weak and widely divergent branches, one joining up with M_4 above, and the other with $Cu_2 + 1A$ below. Cu_2 fuses with 1A not far from its origin.

Originally I placed the genus *Mesochorista* in the family *Panorpidæ*. But its affinities are very great with the recent genus *Tæniochorista* from Brisbane; and this genus, in its turn, is allied to the better known genus *Chorista*. These genera, distinguished amongst other characters by the five- or six-branched media of the forewings and the primitive form of the abdomen in the male, most certainly deserve to be separated out from the *Panorpidæ* as a separate family, *Choristidæ*. I therefore now propose to adopt this family, and to place the Triassic fossil *Mesochorista* in it, together with the two recent genera *Chorista* and *Tæniochorista*. The affinities of the Permian *Permochorista* with the *Choristidæ* are so close that it may also be advisable to reduce the *Permochoristidæ* to the status of a subfamily of the same family.

Genus STEREOCHORISTA, n.g. (Text-fig.23).

Characters of the family, with the following additions:— Forkings of Rs and M placed close together, at a level about two-fifths from base of wing. Apical forkings of the branches of Rs placed more than usually far distad. An oblique cross-vein connecting Rs with M at a level just before that of the origin of the posterior arculus. Branches of M intimately connected by three cross-veins, which form three well-defined closed cells distad from the median fork. 1A apparently three-branched.

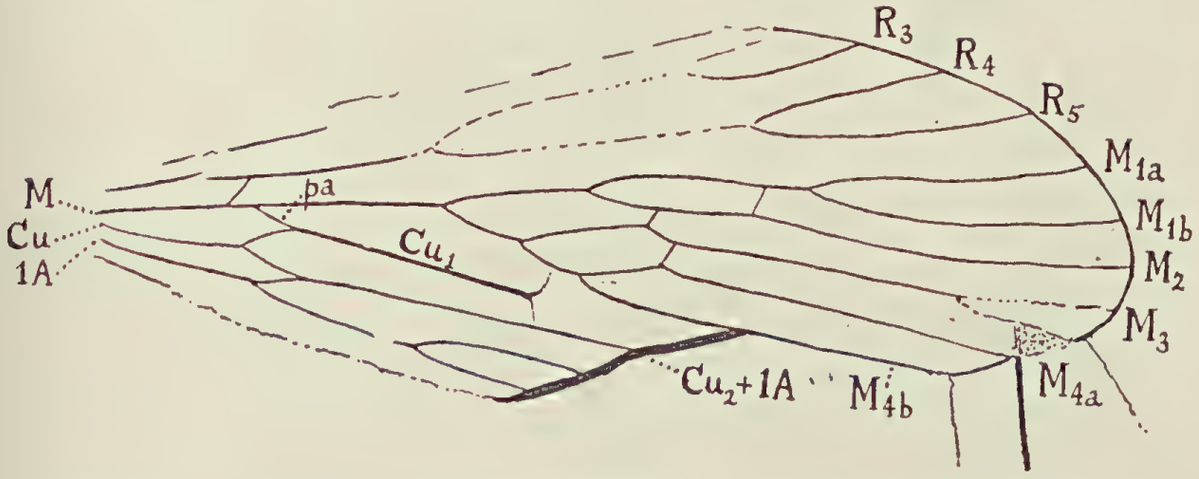
Genotype, *Stereochorista frustrata*, n.sp. (Upper Triassic, Ipswich, Q.).

This genus would appear to be allied to *Mesochorista* (2, p.29) from the same horizon; but the remarkable characters of the presence of a true posterior arculus and the shortened Cu_1 are absolutely unique, and appear to warrant the formation of a new family for its reception. I do not know of any other Mecopteron in which the posterior arculus can be definitely picked out; either it is reduced to a transverse vein, not distinguishable from a cross-vein, or else it is entirely obliterated by reason of the complete fusion of Cu_1 with the main stem of M for a short distance. In this connection, it should be noted that, within the single family *Rhyacophilidæ* in the Order Trichoptera, species can be found showing all three conditions. Undoubtedly the most archaic condition is that exhibited by *Stereochorista*, in common with such species as *Agapetus fuscipes* Curtis (fam. *Rhyacophilidæ*) and with the majority of the *Micropterygidæ*, viz., the presence of a true posterior arculus in the form of an oblique vein connecting the main stem of M with Cu_1, not far distad from its origin at the cubital fork. The condition in *Stereochorista* strongly suggests that the vein usually called Cu_1, distad from *pa*, is in reality a fused vein consisting of Cu_1 and a posterior branch of M, which we may call M_5, and of which *pa* is the basal free piece. If so, then the name *posterior arculus*, due to Comstock, is a misnomer, and should be altered either to *anterior arculus* (this being the part of the Odonate arculus formed from M) or simply to *arculus*.

Further evidence on this interesting point may be found on p.207 of this paper.

STEREOCHORISTA FRUSTRATA, n.sp. (Text-fig.23).

Total length 7·5 mm., this being almost the full length of the wing (a little of the base missing). *Greatest width* of preserved portion, 2·3 mm., representing an actual greatest width of the complete wing of about 3 mm. The impression of the wing is faint but good; there can be no doubt of the correctness of the condition of Cu_1 as drawn, but the tracing of the closely arranged branches of M is not an easy matter. Cu_1 can be followed quite



Text-fig.23.

Stereochorista frustrata, n.g. et sp., forewing. Upper Trias of Ipswich, Q. *pa*, posterior arculus. Rest of lettering as usual in Comstock-Needham notation; (×12).

clearly as a strong vein for some distance, when it suddenly ends quite definitely, sending very weak and widely diverging branches (possibly cross-veins) to M_4 above and $Cu_2 + 1A$ below. A careful examination of these two veins shows us that M_{4b} and $Cu_2 + 1A$ are definitely tending to converge, so that there is not a sufficiently wide space left between them distally for Cu_1 to be continued; this may possibly account for the peculiar manner in which it ends. I have carefully examined the whole of the wing in this region, and can find no evidence of any break or damage; the condition of Cu_1 is evidently a natural one, though certainly most unusual.

The preserved wing was almost certainly the forewing of a highly reduced type, which may very possibly have closely resembled the recent *Nannochoristidæ* in appearance.

Type, Specimen No.218 (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

MECOPTERON INCERTÆ SEDIS. (Text-fig.24).

Specimen No. 168*a*, *b*, consists of two fragments of a small Mecopterous wing, fairly well preserved, but not sufficiently complete to merit a name. Text-fig.24 shows the venation of these fragments. In the larger there are four forked veins, the third and fourth being separated by a simple vein, while the fourth is also followed by another simple vein. Hence it may be suggested that the wing belongs to the *Choristidæ*, the first

Text-fig.24.

Two fragments (*a*, *b*) of Mecopterous wings from Upper Trias of Ipswich, Q.; Specimen No.168*a*, *b*; (×13).

two forked veins representing the branches of Rs (with R, Sc, and the costal border indicated above them in order); while the third and fourth forked veins, together with the simple vein between them, and the simple vein posterior to the fourth, represent the six branches of the media. The positions of these veins, and their angles of divergence from one another, agree closely with those of other *Choristidæ*, but the relative positions of the

dichotomous branchings are quite different from those of any known form.

Panorpoid Insect incertæ Sedis.

Specimen No. 114*b* is a badly-preserved wing which appears to belong to one of the Panorpoid Orders, but which cannot be determined with certainty. Parts of Sc, R, M, and Cu_1 are visible. R_1 is forked distally, Rs dichotomously forked many times over, M apparently five-branched, and Cu_1 straight and unforked. Length of fragment, 9·5 mm.; greatest breadth, 3·5 mm. The costal space was moderately wide, and shows portions of an archedictyon; there are also some slight signs of the same kind of meshwork in other parts of the wing.

This insect may perhaps be related to the Protomecoptera; but is so poorly preserved that I do not propose to name it.

Order **PARATRICHOPTERA**, ordo nova.

Triassic insects with wings in which the venation is on the Trichopterous plan, but differing from the true Trichoptera in two very important points, as follows:—

(1) The three anal veins remain quite separate in the forewing. (In all true Trichoptera these three veins are looped up together in a very typical manner).

(2) Cu_1 is a strong, straight, convex vein, without any apical fork. (In all archaic genera of the true Trichoptera, Cu_1 is forked apically).

A separate costal vein may be present. Rs and M both four-branched, as in archaic genera of recent Trichoptera; both the radial and median cells closed.

The discovery of the almost complete and remarkably well-preserved wing of *Aristopsyche*, n.g., shows that I was in error, in No. 1 of this Series(3), in restoring the forewings of *Mesopsyche* and *Triassopsyche* on the typical Trichopterous plan, as regards the looping-up of the anal veins. I may also have been wrong in determining the presence of the wing-spot (a difficult thing to be certain of, in any fossil) since neither of the two new genera here dealt with shows any signs of it.

The archaic condition of the anal veins, and the unforked Cu_1, connect the new Order with the Mecoptera. It seems likely also that the Paratrichoptera were closely allied to the Diptera, which also have an unforked Cu_1, though the anal veins have undergone a reduction due to narrowing of the base of the wing.

The four genera of Paratrichoptera now known from Ipswich may be provisionally included within a single family, *Mesopsychidæ*, the characters of which were defined in No.1 of this Series (3, p.180). The following key will distinguish them :—

(1) A short costal vein present, separate from the costal margin; all four apical forks free of cross-veins .... ARISTOPSYCHE, n.g.
(1) No separate costal vein (or basal part of costa not preserved); at least one apical fork with definite cross-veins ..... 2.

(2) Sc and R very close together; pterostigmatic region very long and narrow .... 3.
(2) Sc and R further apart; pterostigmatic region not so narrow, less regularly shaped; third apical fork with a cross-vein.. ..... TRIASSOPSYCHE Tillyard.

(3) Only two or three costal veinlets present; second apical fork subdivided into three cells by cross-veins..... MESOPSYCHE Tillyard.
(3) Numerous costal veinlets present; first apical fork with two cross-veins; second apical fork undivided ..... NEUROPSYCHE, n.g.

Genus ARISTOPSYCHE, n.g. (Text-fig.25).

Characters of forewing :—Large wing with broadly rounded apex and very regular scheme of venation; no excess cross-veins in distal part of wing. A short but distinct costal vein present, ending on costal margin at about one-fifth of the total wing-length; veinlets are present both between this vein and the costal border, and also between Sc and the same border. Sc and R both straight, fairly close together; pterostigmatic region moderately long and narrow, with one veinlet. Both the radial (discoidal) and median cells closed, with all four apical forks sessile upon them, though the third fork is only just so. Cu_1 a very strong, convex vein slightly bent downwards distally; not forked, but giving off two very strong, oblique, posterior branches to join the vein below, which is probably Cu_2. Cu_1 distinctly

joined to M near base. Anal veins distinct and quite separated distally.

Genotype, *Aristopsyche superba*, n.sp. (Upper Triassic, Ipswich, Q.).

This genus would appear to be fairly closely allied to both *Mesopsyche* and *Triassopsyche*. The form of the radial cell resembles that of the latter genus very closely, while the form of the median cell, with its peculiarity of having the medio-cubital cross-vein attached almost exactly to the origin of M_4, resembles that of the former genus. In the peculiar form of Cu_1 there is also a close resemblance to *Triassopsyche*; in this latter genus, only enough of the wing is preserved to show the more distal of the two descending branch-veins, and the more distal part of Cu_1 is somewhat zigzagged, through being braced by excess cross-veins, not present in *Aristopsyche*.

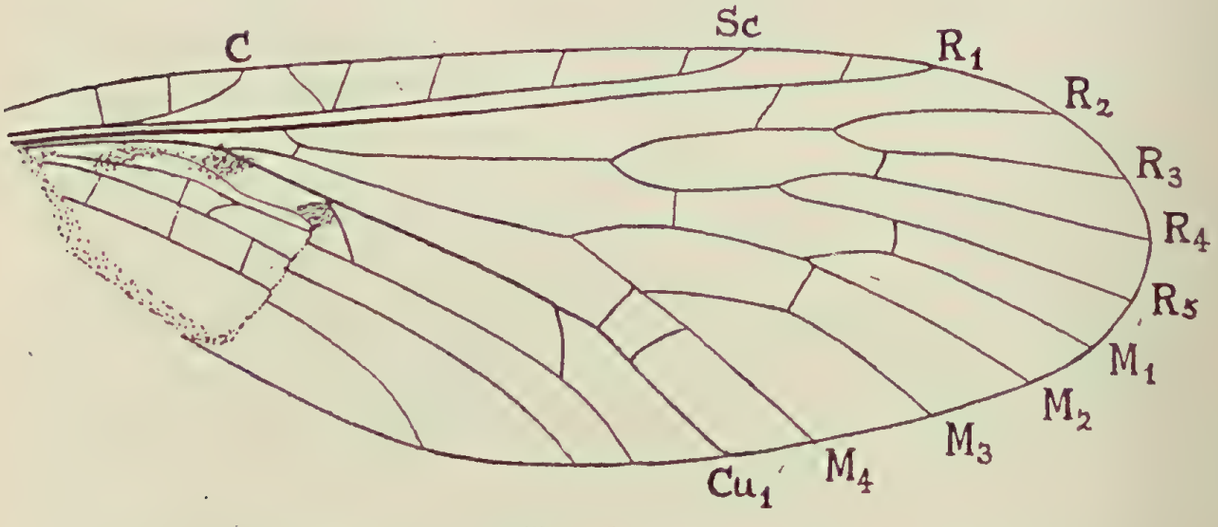
It is much to be regretted that, perfect as this fossil is (with the exception of a single break across the anal veins), some cuts made by the knife in exposing it have, most unfortunately, partially destroyed the impression in the region where the cubital fork should occur, so that it is not possible to determine with certainty the true course of the veins Cu_1 and Cu_2 at their origins.

That the wing is truly a forewing there can be little doubt, not only because the fourth apical fork is present, but also because of the distinctness of the impression, the evident strength of the veins, the well-formed costal area, and the general shape of the wing. The difference between the formations of the anal veins in this fossil and in the forewings of all true Trichoptera is very remarkable; and there seems to be no doubt that the anal areas of the forewings of the other three genera from Ipswich must closely resemble this also. For *Triassopsyche* is so close to *Aristopsyche* that we are bound to conclude a close similarity in the form of their anal veins, though these are not preserved in the former genus. Moreover, in *Neuropsyche*, n.g., which will be seen to be equally close to *Mesopsyche*, some of the anal area is preserved, and is found to be closely similar to that of *Aristopsyche*.

ARISTOPSYCHE SUPERBA, n.sp. (Text-fig.25).

Greatest length of fossil, 24 mm. (representing a complete wing about 25 mm. long, with a small piece of the extreme base missing); *greatest breadth*, 8·2 mm.

This fossil is perfectly preserved, except for a small portion of the base and anal area; the wing had evidently been torn transversely across the anal veins before becoming fossilised, so that these veins are all slightly displaced basally. A weak, irregular curved line below the basal portion of Cu_1 appears to represent the crinkle in the wing-membrane due to this displacement. The first vein lying below this crinkle should be Cu_2, the second 1A, and the third 2A, 3A being apparently obliterated owing to the poor state of preservation of the wing near the base anally. It might be maintained, however, that these three veins were the three anals, Cu_2 being represented either by one of the two oblique descending branches from Cu_1, or possibly even by the weak, curved line which I have preferred to interpret as a crinkle in the membrane.



Text-fig.25.

Aristopsyche superba, n.g. et sp., forewing. Upper Trias of Ipswich, Q. C, distal end of short costal vein; rest of lettering as usual in Comstock-Needham notation; (×4).

Cross-veins present are:—two between the costal border and the short separate vein C; five between the costal border and Sc, of which the most basal is bent backwards towards the tip of

C; one in the pterostigmatic space; one between R_1 and R_{2+3}; one between R_3 and R_4, closing the radial cell distally; one from R_{4+5} to M_{1+2}; one from R_5 to M_1; a short one connecting Rs with M, quite close to the origin of the former; one between M_2 and M_3, closing the median cell distally; one from near the origin of M_4 to Cu_1, with a second somewhat distad from it; an oblique one (possibly a branch veinlet) from 1A to Cu_2; and three between 1A and 2A. The two oblique veins running from Cu_1 downwards are very strongly marked, and quite different from the other cross-veins; so that I have little doubt that they represent true branches of this vein.

Type, Specimen No. 148*a*. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

Genus NEUROPSYCHE, n.g. (Text-fig.26).

Characters of forewing:—A moderate-sized wing with narrow costal area and very narrow, elongated radial cell; pterostigma very long, without any veinlets. Numerous veinlets in costal area, also a number of excess cross-veins scattered irregularly. Sc and R very close together. First and second apical forks very narrow and close together; third and fourth broad and normally placed. Cu_1 a straight vein without any branches in the preserved part; the same is true of Cu_2 and 1A. Both radial and median cells closed, the first, second, and fourth apical forks sessile, the third very definitely stalked.

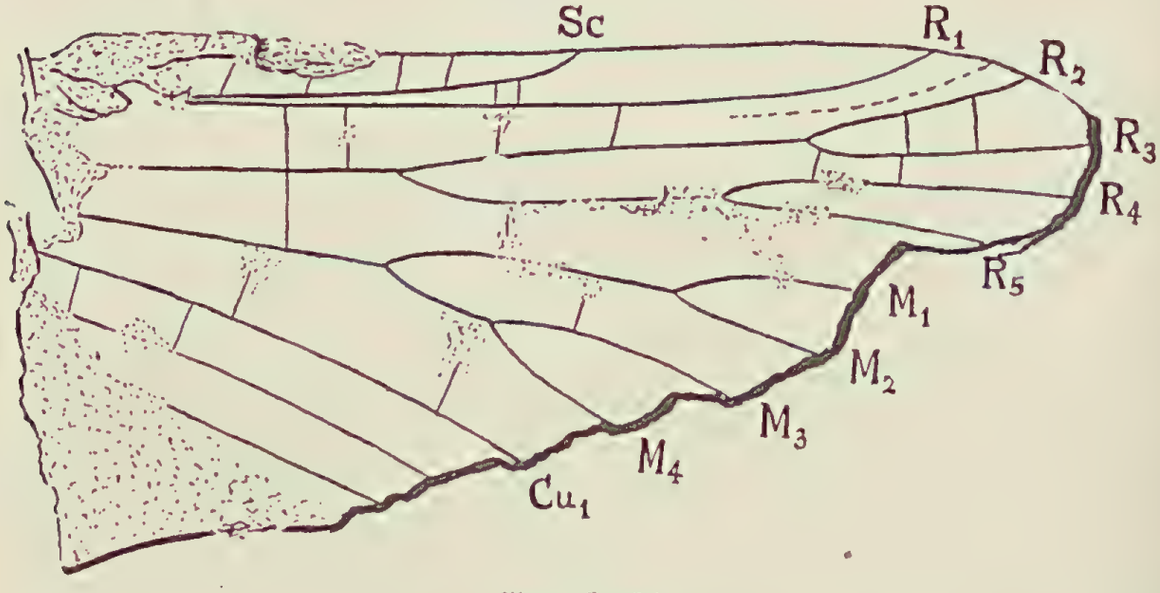
Genotype, *Neuropsyche elongata*, n.sp. (Upper Triassic, Ipswich, Q.).

Evidently closely allied to *Mesopsyche* from the same horizon. It differs from the latter genus in lacking the subdivision of the second apical fork into three separate cells, but possesses instead two cross-veins in the first apical fork. In *Mesopsyche* the costal area is not crossed by numerous veinlets, nor is the third apical fork stalked, but arises exactly from the upper distal angle of the median cell. *Mesopsyche* also lacks the excess cross-veins which are so conspicuous in the new genus.

NEUROPSYCHE ELONGATA, n.sp. (Text-fig.26).

Greatest length of fragment, 11 mm, representing a wing whose total length was about 16·5 mm. *Greatest breadth*, 4·8 mm.

The impression is a faint one, but can be made out with very little difficulty in a good light. All the basal part of the wing, together with the extreme distal part, from the apex obliquely downwards to the distal ends of Cu and 1A, is missing. In the short distal end of the costal area preserved, no less than four veinlets are visible; so that it is fairly certain that this area was well supplied with veinlets the whole way along. Below the apical end of Sc, two small cross-veins pass downwards to R; but the whole of the true pterostigma is smooth and free of veins.



Text-fig.26.

Neuropsyche elongata, n.g. et sp., forewing. Upper Trias of Ipswich, Q; (×8). Lettering as usual.

The pterostigmatic furrow is well marked, between R_1 and R_2. Other cross-veins present are:—four between R_1 and Rs, of which the most basal passes on in a straight line to M; two between R_3 and R_4, one closing the radial cell, the other slightly distad from it; one (not well preserved) between R_{4+5} and M_{1+2}; one closing the median cell distally; two between M and Cu_1; and two between Cu_1 and Cu_2.

Type, Specimen No. 228*a*. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

A study of the four genera of Paratrichoptera now known from Ipswich makes it extremely questionable whether they can be regarded as lying in the direct ancestral line of the present Trichoptera. It is, of course, quite certain that recent Trichoptera must have been originally derived from Trichopterous-like insects in which the high specialisation of the anal veins, now present throughout the Order, had not been established. But all archaic recent Trichoptera have a very definite dichotomy of the first cubitus distally, forming the *fifth apical fork*; whereas it is quite evident that the Paratrichoptera did not possess this fork, but had instead a straight Cu_1, of the type seen in all fossil and recent Mecoptera.

Order **PLANIPENNIA.**

Family PROHEMEROBIIDÆ.

In No.1 of this Series (3, p.178), I described from Ipswich the genus *Protopsychopsis*, placing it in the above family for reasons there given. Since then, I have received a very beautifully preserved fragment of a Prohemerobiid wing, showing most of the basal part of the wing, with all the most important veins preserved. This fossil appeared at first to be so exactly like the recent *Megapsychops illidgei* that I began to think that the family *Prohemerobiidæ* could no longer be maintained. However, a careful study of the new fossil shows certain important differences, which, taken in conjunction with our knowledge of the Liassic and Jurassic *Prohemerobiidæ* of Europe, and of the recent *Psychopsidæ*, make it quite certain that the former family must be maintained; while it is now capable of definite proof that the latter family is a direct descendant therefrom. This proof will be furnished below, after the definition of the new genus, and the description of the fossil, have been given.

Genus ARCHEPSYCHOPS, n.g. (Text-fig.27).

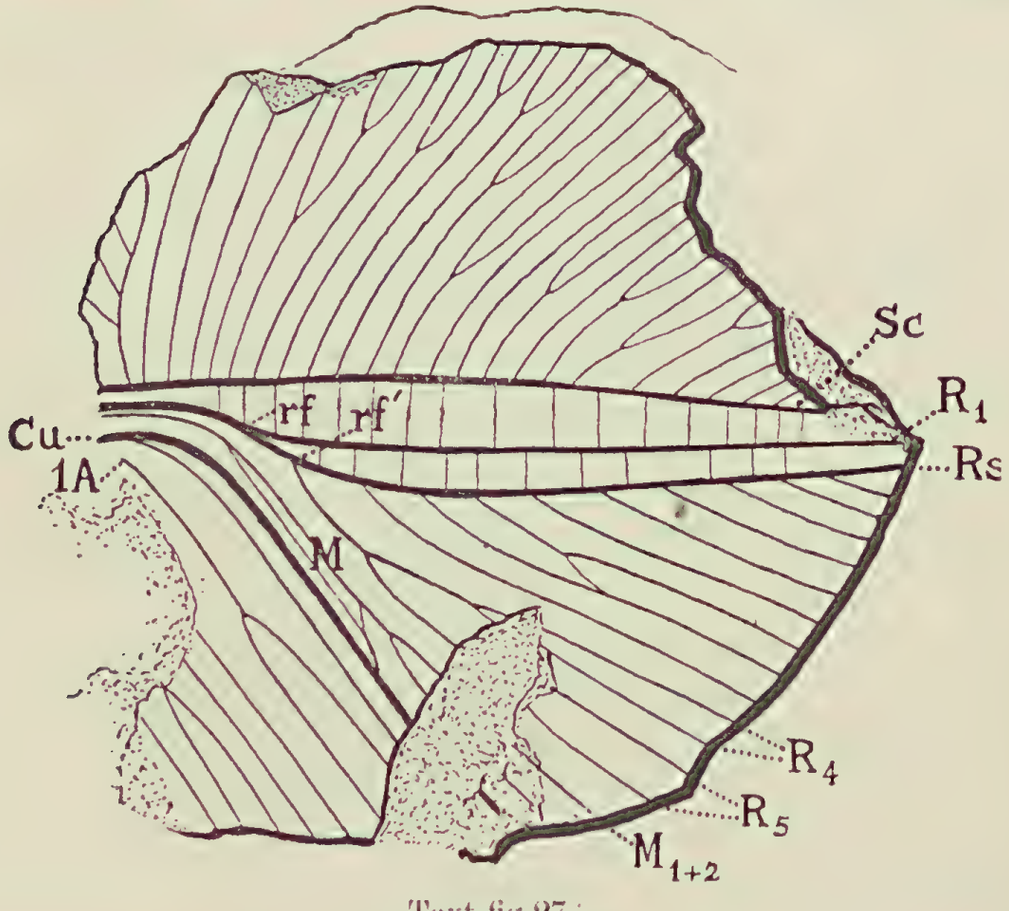
Characters of preserved basal part of forewing as in the recent *Megapsychops*, with the following differences:—Costal veinlets at extreme base arising at right angles to Sc, the recurrent vein

giving off anterior branches only (as in hindwing of *Megapsychops*); further distad, the direction of these veinlets changes rapidly, until, at the most distally preserved part of the wing, they make an angle of only about 30° with Sc. *No costal series of cross-veins between the costal veinlets.* The most basal branch of Rs ($= R_{4+5}$) still preserves its dichotomous branching, and both R_4 and R_5 again branch dichotomously in the preserved part. 1A also dichotomously branched.

Genotype, *Archepsychops triassica*, n.sp. (Upper Triassic, Ipswich, Q.).

ARCHEPSYCHOPS TRIASSICA, n.sp. (Text-fig.27).

Greatest length of fragment, 6·7 mm.; *greatest breadth*, 6 mm.



Text-fig.27.

Archepsychops triassica, n.g. et sp., preserved portion of forewing. Upper Trias of Ipswich, Q.; *rf*, primary radial fork; *rf'*, secondary radial fork; rest of lettering as usual; (× 10½).

(Measurements of the corresponding portions of the forewing of *Megapsychops illidgei* are almost exactly the same size; so that

the fossil should represent a portion of a large wing of about the same size as that of *M. illidgei*, viz., about 27 mm. long). All the main veins and branches beautifully preserved, very strongly formed; the cross-veins, which are only present between Sc and R_1, and between R_1 and Rs, are weak and difficult to make out, but can be clearly seen in oblique evening sunlight. Sc, R_1, Rs, and Cu_1 are exceptionally strong veins, as also in *M. illidgei*. The direction of Cu_1, which makes an angle of as much as 50° with Rs, is quite exceptional, but is about the same as in the forewing of *M. illidgei*; likewise the weak formation of Cu_2, and its position parallel and very close up to Cu_1, is similar in both. No less than ten branches of Rs are present in the preserved portion of the wing; so that the total number of branches must have been very large, as also in *M. illidgei*. The formation of M is peculiar. Owing to the strength and thickness of Cu_1, which stands on a high ridge, it is not easy to make out the exact formation of the much weaker concave vein M near its base. But, viewed with a good light in the right direction, there can be seen a weak posterior branch of M arising from the main stem quite close to the base, and running between and parallel to M and Cu_1, until it meets with an oblique cross-vein descending from M just before the first clear dichotomy; it then curves in to join Cu_1 just below the dichotomy of M. Being in doubt as to the interpretation of this peculiar formation, I examined the forewing of *M. illidgei*, and there found, in the same position, a distinct but weak branch of M arising in the same manner, and ending on a cross-vein descending from the first evident dichotomy of M, as shown in Text-fig. 28, *a*. As this character appears to be of some importance, I also examined the forewing of *Psychopsis elegans* (Guér.), and was surprised to find a closely similar formation there. I think that there can be little doubt that this vein, which I unfortunately overlooked in my previous studies of the *Psychopsidæ*, is really the posterior branch from the first dichotomy of M, and should therefore be called M_5. It must evidently be the homologue of the vein called the *posterior arculus* by Comstock in the Trichoptera and Lepidoptera, and also visible in the Mecopteron *Stereochorista* described on p. 196

of this paper. It will follow from this that the primary median fork, like the primary radial and cubital forks, lies close to the base of the wing, and that the more distal fork, which has hitherto been regarded as the median fork, is really the secondary median fork, homologous with the secondary radial and cubital forks. Beyond the formation already described, only one dichotomy of M_{1-4} can be seen in the fossil; but there were almost certainly further dichotomies in the lost portion, judging by the somewhat diverging directions of the branches of M and of R_{4+5}. (M has at least four branches in *M. illidgei*, apart from the vein M_5 already mentioned).

Type, Specimen No. 137*a*. (Coll. Queensland Geological Survey).

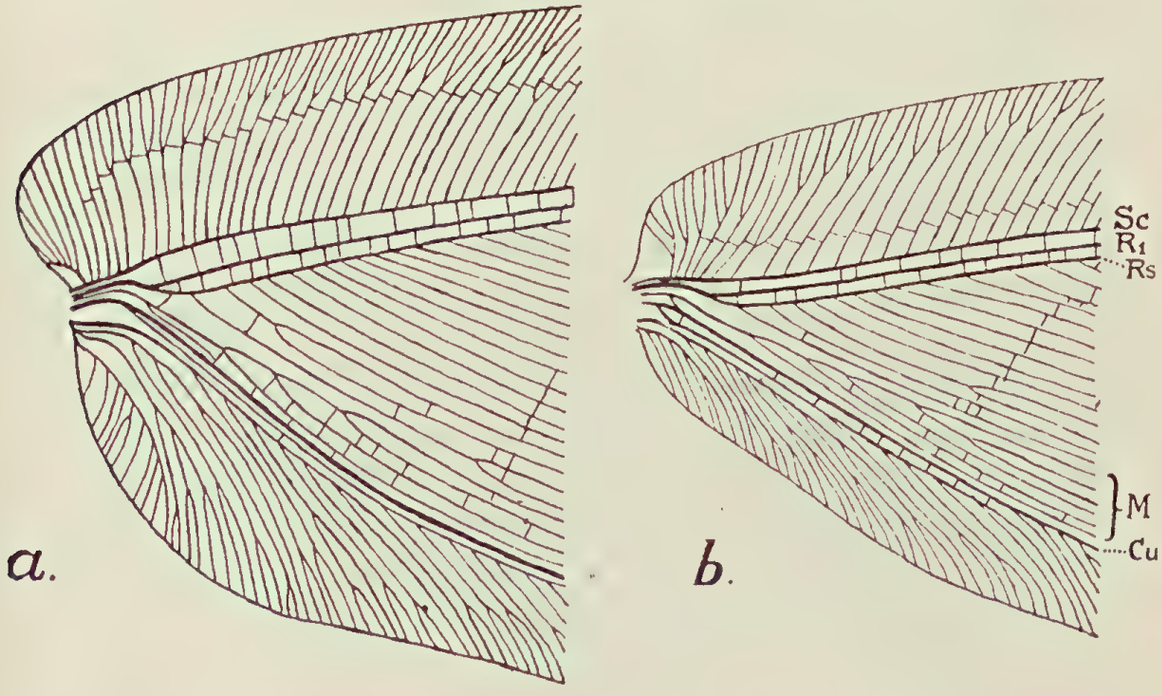
Horizon: Upper Triassic, Ipswich, Q.

Discussion of the Relationship between the Fossil Prohemerobiidæ *and the Recent* Psychopsidæ.

In Text-fig. 28, I show the bases of fore- and hindwings of *Megapsychops illidgei* (Froggatt), the most archaic of existing *Psychopsidæ*, for comparison with the fossil *Archepsychops*. It should be stated, at the start, that the venation of *Megapsychops* is absolutely unique, and that there is no other known insect, fossil or recent, which possesses the same characters, or anything closely approaching them. From the rest of the *Psychopsidæ* it is widely separated by the large number and closeness of the branches of Rs, the four- to six-branched media, and the remarkable structure of the cubitus.

Comparing Text-figs.27-28, we see that the forewing of the fossil *Archepsychops* is intermediate between the fore- and hindwings of *Megapsychops* in the form of the costal veinlets—the immense breadth of the costal space resembling that of the *forewing* of this latter genus, while the type of branching of the recurrent costal veinlet is that found in the *hindwing* only of *Megapsychops*. Apart from the absence of the costal series of cross-veins, which never occurs in any Prohemerobiid, the principal difference between the forewings of *Archepsychops* and *Megapsychops* is the great change in the direction of the costal

veinlets in the former, even in the short space of the wing preserved in the fossil. This character might be passed over as of little importance, were it not quite incompatible with the fundamental character of the family *Psychopsidæ*, viz., the broadly rounded apex, with wide costal area from base to tip. Those Liassic and Jurassic *Prohemerobiidæ* which are best preserved



Text-fig. 28.

Megapyschops illidgei (Froggatt). Basal third of forewing (*a*) and hindwing (*b*) for comparison with Text-fig. 27; (×5).

show, for the most part, a costal area fairly broad at the base, but rapidly narrowing towards the apex, which is always much less rounded than that of the *Psychopsidæ*; concurrently with this more primitive shape, there is an entire absence of any formation of a *vena triplica*, the three veins Sc, R_1, and Rs remaining primitive in form from base to apex. Now, if we turn to the study of the wings of any Psychopsid, we see that the broad apex, together with the specialisation of the greater parts of Sc, R_1, and Rs as a *vena triplica*, is correlated with a condition of the costal veinlets which is quite different from that found in the fossil. In the *Psychopsidæ*, these veinlets, from near the base right up to near the end of the *vena triplica*, come

off at an angle exceeding 45°, and all are approximately parallel to one another. Thus, a little thought will show us that the condition of these veinlets shown in the fossil is definite proof that the wide costal area existing at the base does not continue further distad, and that the more distal portion is of the narrower Prohemerobiid type.

Further evidence in the same direction is afforded by the existence in the Ipswich Trias of the Prohemerobiid *Protopsychopsis venosa* Tillyard, described by me in No.1 of this series (3, p.178). This fossil is only represented by the apical portion of the wing, which is of true Prohemerobiid type, with narrow costal area. It is not possible, owing to obvious differences of size, that *Protopsychopsis* and *Archepsychops* represent apical and basal portions of the wing of the same species; but it is extremely probable that they are parts of the wings of two closely allied insects, and very unlikely that they represented two distinct families. Indeed, if we were to restore *Archepsychops* on the supposition that its apical portion resembled that of *Protopsychopsis*, we should obtain a Prohemerobiid wing in its entirety, and there would be no clashing of characters anywhere.

Turning now to the relationship of *Archepsychops* to the recent *Megapsychops*, we see at once that *there is not a single character present in the former which is incompatible with its being considered as the direct ancestor of the latter.* When we consider how unique *Megapsychops* is in its venation, we must see that this is a very remarkable thing. If we add to this, that the differences in size of the two insects, and in the strength and closeness of their veins, are practically negligible, and that *Megapsychops* at the present day is only known to inhabit an isolated mountain-top situated some thirty miles from the Ipswich Fossil Beds, we see how strong a case there is for considering the fossil *Archepsychops* to be the *direct ancestor* of the recent *Megapsychops*. If this be accepted, then it has also been demonstrated that the *Psychopsidæ*, as a family, are the direct descendants of the older *Prohemerobiidæ*; the changes required to evolve the one from the other, through the immense period of geological time beginning with the Upper Trias, being really

only a change in the shape of the wing, with its consequent alteration in the size and direction of the costal veinlets, and with a correlated specialisation in three parallel main veins, to form the *vena triplica* (as a kind of backbone or rachis for the widened wing), and a further strengthening of the veinlets by formation of the costal series of cross-veins.

There is one other point of interest in the venation of *Archepsychops*. Comstock, in a recent work (1), has elaborated the theory of the origin of the Planipennia from an older stock with dichotomously branching wing-veins, such as we find in the Mecoptera and Trichoptera. The condition of R_{4+5} in the new fossil is direct evidence in favour of this, but *not* in favour of the restriction of the number of dichotomous branches of both Rs and M to *four*, which Comstock also holds. For it is quite clear that both R_4 and R_5, in this fossil, are again dichotomously branched not far from their origins; and quite possibly they may be even branched again, further distad. Thus, we should conceive of the ancestral form as having, indeed, truly dichotomously branching sectors of Rs and M, but without any unnecessary limitation of the number of those dichotomies. Such a type is to be seen in the Protomecoptera, also from the Ipswich Trias, in which the number of branches of Rs is very large, but all are clearly *primitive dichotomies*. If we could find the type that gave rise to both *Archipanorpa* and *Archepsychops*, we should most probably have discovered the ancestor of the whole of the Panorpoid Orders.

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3. ————————, 1917.—"Mesozoic Insects of Queensland. No. 1. Planipennia, Trichoptera, and the new Order Protomecoptera." These Proceedings, xlii., Part 1, pp. 175-200, text-figs. 1-7, Pl. vii.-ix.
4. ————————, 1918.—"Mesozoic Insects of Queensland. No. 3. Odonata and Protodonata." These Proceedings, xliii., Part 3, pp. 417-436, text-figs. 11-16, Pl. xliv.-xlv.

Note on Archipanorpa magnifica (*Order Protomecoptera*):—In No. 1 of this series(3), I gave two drawings of the archedictyon or primitive meshwork of the wings of this fine fossil, one in Text-fig. 6, the other on Pl. viii., fig. 6. I now desire to draw attention to the fact that I have succeeded in making photo-micrographs of this structure, and that they have recently been published in Part 2 of "The Panorpoid Complex" (These Proceedings, 1918, xliii., Part 3, Pl. lxvii.). These photographs give a much more accurate idea of the true appearance of the archedictyon, the previous drawings having been diagrammatic, and, therefore, possibly somewhat misleading as regards the detailed structure of the meshwork.

Archipanorpa magnifica Till., archedictyon or primitive mesh-work of the wing.

[*From the Proceedings of the Linnean Society of New South Wales, 1919, Vol. xliv., Part 2, 30th July.*]

MESOZOIC INSECTS OF QUEENSLAND.

No.6. Blattoidea.

By R. J. Tillyard, M.A., D.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(Text-figs. 29-40).

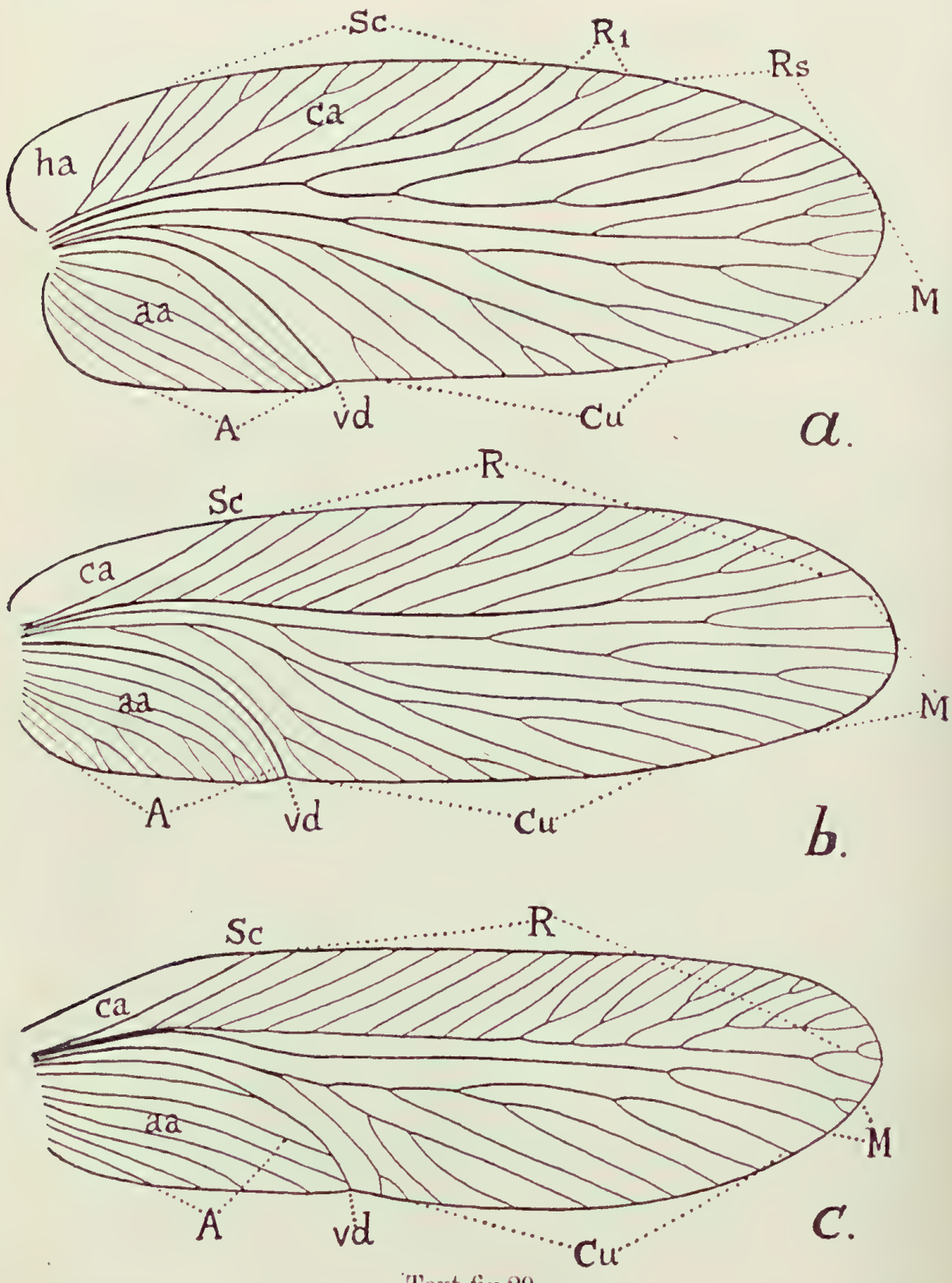
Although regarded by many entomologists as forming only a single family, or at most a Suborder, within the Order Orthoptera, the Cockroaches comprise the vast majority of the known fossil insects of Palæozoic times, and were evidently the dominant group during the Upper Carboniferous and Permian of the Northern Hemisphere. Consequently, they have come to be studied apart from the rest of the Orthoptera; and many attempts have been made to indicate for them characters of ordinal value, which should set them completely apart from the rest of that Order. Such characters are to be found in the oval, much flattened body; the large oval pronotum, beneath which the head is almost wholly concealed; the huge coxæ; the similarity in the structure of all three pairs of legs; and especially in the shape and venation of the tegmina or forewings. I must confess my inability, at present, to see anything of more than subordinal value in all these characters. The Cockroaches appear to me to be essentially the most generalised of Orthoptera; and I propose to use the group-term Blattoidea as indicating a distinct, archaic Suborder within the Order Orthoptera.

The great majority of fossil cockroaches are represented either by a single tegmen, or part of it, or at most by the two tegmina *in situ*, folded down the back of the insect. Hindwings are comparatively rare, owing to their much greater delicacy of texture, and the slight chance of their being preserved intact, or, if preserved, of leaving any reasonably clear impression upon the rock in which they become imbedded.

The study of fossil cockroach tegmina is almost a special branch of Entomology by itself, and has been brought to considerable perfection by Scudder, Brongniart, Handlirsch, and others. For the purpose of dealing adequately with the fossil Blattoidea so far found at Ipswich, it would appear sufficient if we indicated the typical venational scheme of a cockroach tegmen, and pointed out the main lines of specialisation which are shown in the evolution of this type of forewing, from its first occurrence in the Upper Carboniferous, down to the present day.

Text-fig.29 shows three very typical cockroach tegmina, one from the Upper Carboniferous of Europe, another from the Lias of Europe, and a third from a still existing genus of Australian cockroaches. All three agree in the general shape of the tegmen, though it may be said that the average breadth, in comparison with the length, is greatest in the oldest forms, and decreases as we pass up through the Mesozoic forms to those of the present day. All three likewise agree in the very definite marking off of a somewhat cultriform *anal area* or *clavus*. This character is one of the most distinctive of the true cockroach tegmen, and the area in question is generally excellently preserved in fossils.

The differences between the three types are fairly obvious. In the Carboniferous fossil, the subcostal vein (Sc) was well developed, sending many branches to the anterior border of the wing, and occupying at least half of that border. The only space devoid of branch-veins is a small portion of the costal area, at its extreme base, which we may term the *humeral area* (Text-fig.29*a*, *ha*). The space lying between the anterior border of the tegmen and the main stem of the subcosta, and including, therefore, not only the humeral area proper, but also the whole area supplied by branches of Sc, is the true *costal area* (Text-fig. 29, *ca*). In the Mesozoic and recent types figured, the subcosta becomes reduced to a simple vein, which borders the costal area distally; and the latter becomes, like the humeral area of the older type, free of branch-veins. There are, of course, many Carboniferous types that show stages in this reduction; but they are not dominant types for that period. Thus the *Poroblattinidæ*



Text-fig. 29.

Venation of Blattoid tegmina. *a*. Genus *Phyloblatta*, family *Archimylacridæ* (diagrammatic), Upper Carboniferous of Commentry, France. *b*. *Rhipidoblatta geikiei* Scudder, family *Mesoblattinidæ* (enlarged from Handlirsch), Lias of Moreton Bagot, England. *c*. *Escala circumducta* (Walker), family *Blattidæ*, recent, Australia ($\times 7\frac{1}{2}$).

show the subcosta reduced to a few veins—an intermediate stage between *Phyloblatta* (Text-fig.29*a*) and *Rhipidoblattina* (Text-fig. 29*b*). This latter genus belongs to the *Mesoblattinidæ*, which, represented by only three genera in the Upper Carboniferous become more important in the Permian, and finally reach the dominant position among Mesozoic Blattoids.

Let us next consider the radius (R). In the type exhibited by *Phyloblatta*, we can usually indicate the boundaries of the main stem of R (R_1) and the radial sector (Rs) respectively. Thus these cockroaches fall into line with almost all other insects in this respect. But when the radius supplants the subcosta, as in the Mesozoic and recent forms, it tends more and more to take on the original character of that vein, viz., a single, gently curving main stem, giving off only anterior branches to the wing-border. There are many forms in which this process can be seen uncompleted; yet, in general, we may say that the limits of R_1 and Rs become no longer clearly evident, and it is best to consider the radius, for purposes of description, as a single main stem with many anterior branches.

The media (M) tends to alter very little throughout all Palæozoic and Mesozoic forms. It always supplies about the same area of the wing, viz., a more or less triangular area covering the middle line of the tegmen, including the apex and portion of the wing-border below it. In the recent form figured (Text-fig.29*c*), the media is shown much reduced, and fused basally with the radius. A reduced media is found in a few Mesozoic forms, but its basal portion is never fused with R in these fossils. There are also many genera still existing in which the media remains free and many-branched.

The cubitus (Cu) also tends to alter very little. In the great majority of forms it supplies the broadly triangular area lying below the middle line, sending branches to the posterior border, from below the most posterior branch of M to near the anal area. The manner and number of these branches is very variable in all forms.

The most characteristic structure in all Blattoid tegmina is the sharply marked-off *anal area* or *clavus* (Text-fig.29, *aa*). This

somewhat cultriform area is separated from the rest of the tegmen by a deeply impressed vein, called the *vena dividens* (*vd*). This vein, in the Comstock-Needham system, must be either Cu_2 or 1A; but, as it does not seem to be quite clear, as yet, which of these it really is, it is best to keep to the non-committal name still in use with students of the Blattoidea. The anal area itself is more or less convex, and hence it is usually very well preserved in fossils, making a deep impression on the rock, much as a Coleopterous elytron does.

The veins supplying the anal area are termed either *anal veins* or *axillaries* (Text-fig.29, A); we shall adopt the former term. In the Palæozoic fossils, they all spring from the base, and take a more or less oblique course towards the posterior border; none of them ends upon the *vena dividens*. The same is true of most Mesozoic fossils, though occasionally one, or perhaps two, of the more anterior ones may be found to end up on the *vena dividens*, just above the apex of the anal area. Recent forms with the same condition still exist; but there are also many forms in which, as in the one figured in Text-fig.29c, the anal veins distribute themselves alike equally to the *vena dividens* and the posterior border, or even run mostly longitudinally to the former only.

We may add to this account that, in the great majority of Carboniferous fossils, there is a delicate close network of cross-veins all over the tegmen; this is apparently a specialisation from the older and more irregular palæodictyopterous meshwork, or *archedictyon*, found in the Palæodictyoptera, Protorthoptera, and Protoblattoidea. Intercalated veins are very rarely developed. In the Mesozoic fossils, on the other hand, intercalated veins are often well developed, while the close network of cross-veins is more rarely found. Most recent forms have the intercalated veins well developed; and there still exist a number with the cross-venation persisting, though it is seldom of so close a type as in the Carboniferous forms.

Thus, although the Blattoid type of tegmen has remained remarkably stable through many millions of years, we are yet able to see the general trend of evolution, as shown by the

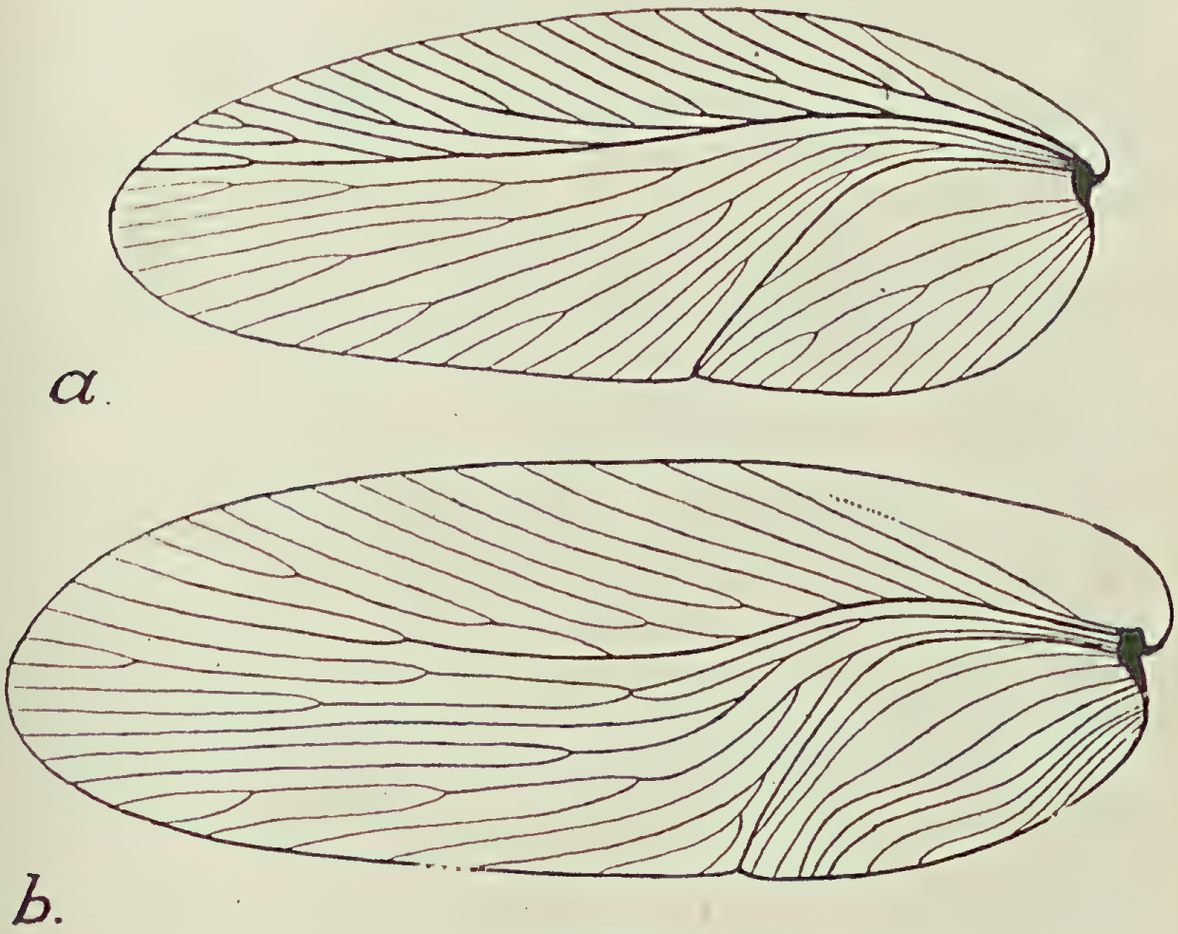
changes in the dominant types at each period. We may sum up these tendencies as follows :—

(1) Tendency towards narrowing of the tegmen.

(2) Tendency towards reduction of Sc, and invasion of the anterior border of the wing by branches from R.

(3) A correlated early tendency towards loss of the clear distinction between R_1 and Rs.

(4) Tendency for the anal veins to migrate distally from their original endings on the posterior margin of the wing, and to end instead upon the *vena dividens*.



Text-fig.30.

Restoration of the tegmen in *a*. *Triassoblatta typica*, n.g. et sp., and *b*. *Samaroblatta reticulata*, n.g. et sp. Both from Upper Trias of Ipswich, Q. (×7½). In *b*, the intercalated ridges and cross-venation are omitted.

We are now in a position to study our new Ipswich fossil Cockroaches with advantage. Text-fig.30 shows the restoration of the tegmina of the two principal genera described in this Part.

Of these two, we must select *Triassoblatta* as the older type; because in it, Sc remains still not reduced to its full limit of a single vein bounding the costal space distally. The radius in this genus shows no strong double curving. This genus might reasonably be put into the *Poroblattinidæ* on the character of its subcosta; but in other respects it comes closer to the *Mesoblattinidæ*, so that a slight extension of the definition, as given by Handlirsch, will enable us to include it as the most archaic member of that family. The other genus, *Samaroblatta*, agrees with *Rhipidoblattina* (Text-fig.29*b*) in its completely reduced Sc, but differs from it in the strong double-curving of R, and in the absence of branchings on the anal veins. It goes naturally into the *Mesoblattinidæ*. The same may be said of the third genus *Austroblattula*, of which it does not seem necessary to give a restoration.

The assemblage of forms described in this paper, then, is just such as we might expect to find in beds of Upper Triassic age. We may note, however, the existence of a much more archaic type in these same beds, in the genus *Austromylacrites* Tillyard, described in a former paper (2, p.13).

Before proceeding to enter upon the descriptions of the new fossils, I desire to express my grateful thanks to Dr. A. Eland Shaw, M.R.C.S., F.E.S., of Wynnum, South Queensland, for his valuable help and criticism upon this Part. The manuscript and Text-figures were sent to Dr. Shaw, who studied them carefully, and was able, owing to his great experience in the group, to suggest a number of useful alterations. My chief discussions with Dr. Shaw centred upon two points, viz., the method of counting the branches of R, and the correct naming of the wing-areas. Both these really depend upon the application of the Comstock-Needham system of venational nomenclature to the Blattoidea, which Dr. Shaw is as anxious to see established as I am, though by long use he has accustomed himself to the different notation in vogue amongst Blattidists. As regards the branches of R, it seems to me, after a study of the known fossil types, that it is quite impossible to say what are the limits of R_1 and Rs in Mesozoic and recent forms. I have, therefore, expressly

stated that I regard R as a single elongated main stem, from which a series of primary branches comes off anteriorly, meeting the costal border. In counting these branches, I do *not* include the small fork or forks that may be present near the tip of this main stem, because I consider these to be only secondary forkings, of the same nature as the branches of some of the forkings of the primary branches themselves. To take an example: – by reference to Text-fig.29*c*, I should say that *Escala circumducta* had a radius with thirteen primary anterior branches, the first nine of which are simple, the next four themselves branched or forked. The last primary branch arises just above the forking of M. To make this quite clear, I should add the phrase "excluding the distal forked end of the main stem," which, as will be seen from the figure, divides into three very short veins This method of description has been followed throughout the paper, and I trust that it will be quite plain.

As regards the naming of the wing-areas, the rule in the Comstock-Needham System is that *each area should be named from the vein that bounds it anteriorly*. This is awkward for the Blattoidea, since it makes the area in which all the branches of R lie, the *subcostal area*. But it is better to put up with this than to make one rule for the Blattoidea and another for those insects in which the branches of R are posteriorly placed. As regards the area served by the branches of Sc, the rule makes it quite clear that the whole area between the costal border and the main stem of Sc must be the true *costal area*, and will contain within itself all the branches of Sc. Hence a new name is needed for the clear basal portion of the costal area which is of such value as a generic character. This I propose to term, in full, *the humeral portion of the costal area*, a term which may conveniently be shortened to *humeral area*, provided it is understood that it is always part of the costal area proper. When Sc becomes a single straight vein, then the humeral area and the costal area coincide, as in *Samaroblatta*, n.g. In some cases, as in *Triassoblatta insignita*, n.g. et sp. (Text-fig.32), the humeral area has its costal border strengthened, and this strong border is continued beyond the first branch of Sc.

Family MESOBLATTINIDÆ Handl.

Subcosta much reduced. Radial area extensive and strongly developed, sending numerous branches towards the anterior border, and reaching nearly to apex. Media free, dividing into a variable large number of branches directed towards the apical border. Cubitus also free, branching variably, the branches directed towards the posterior border. Anal field large, well-defined, usually somewhat cultriform, with more or less curved veins running chiefly towards the posterior border. Intercalated veins and reticulation or cross-venation may or may not be present. Mostly small to medium-sized forms.

The above definition of the family is a slight modification of that given by Handlirsch (1, pp.290, 378, 427), the alterations having been made with a view to the inclusion of one of the new genera from Ipswich, which does not seem to me sufficiently distinct from the described types of the Northern Hemisphere to warrant the formation of a new family for its reception. Besides, the family, as recognised by Handlirsch, already comprises forms from the Upper Carboniferous, the Permian, and the Lias; so that the new forms from the Upper Trias fall naturally into the family, with respect to their geological age, as well as with respect to their characters. The alterations allow forms in which Sc is not reduced to its full extent, and the branches of Cu do not all come off posteriorly, to be retained within the family, and also indicate that the presence of cross-venation is not as exceptional as Handlirsch imagined it to be.

Handlirsch regards the family as directly derivable from the older *Poroblattinidæ*. From the Upper Carboniferous of North America and Saxony he lists three genera, with five species. From the Lower Permian of North America, he gives three genera, with four species (one of these genera, *Nearoblatta*, occurs in both formations). From the Lias of England, Switzerland, and Mecklenburg, he defines no less than ten genera, comprising twenty-four species. Thus the family contains a total of fifteen genera and thirty-three species. Handlirsch also remarks that the family is only poorly represented in the Upper Carboniferous, but becomes more important in the Permian, finally reaching the

dominant position within the Blattoidea during the Lias. We should, therefore, not be at all surprised to find that the cockroaches from Ipswich, with the single exception of the fine genus *Austromylacrites* Tillyard, previously described (2, p.13), fall naturally into this family.

Of the eleven specimens here dealt with, only two (Specimens 121*a-b* and 152) are not named, the former being too poorly preserved, the latter too fragmentary. Of the remaining nine, two cannot be placed with certainty in their correct genera; these are Specimens 216 and 262, the former being a nearly perfect clavus or anal area only, while the latter has neither humeral area nor anal area clearly preserved. The remaining species may be arranged within three genera, on well-defined characters, as shown in the following key :—

(1) Length of humeral area, from base to apex, distinctly less than that of anal area..... TRIASSOBLATTA, n.g.
Length of humeral area, from base to apex, at least equal to that of anal area ..... 2.

(2) Medium-sized tegmina (about 13 mm. long) with the main stem of R fairly strongly double-curved, so that its lowest point of dip reaches almost to the middle line of the tegmen ..... SAMAROBLATTA, n.g.
Small tegmina (less than 10 mm. long), with the main stem of R very slightly curved, its lowest point of dip lying well above the middle line of the tegmen..... AUSTROBLATTULA, n.g.

Genus TRIASSOBLATTA, n.g. (Text-figs.30*a*, 31-33).

Medium-sized to large tegmina from 12 to 21 mm. in length. Humeral area narrow to moderately wide; distinctly less in length, from base to apex, than is the anal area. Sc consisting of a group of sectors, one of which borders the costal area distally, with or without extra branches on that area, but always with at least one branching sector placed distad from it. Main stem of R with very weak double-curving, so that its lowest point of dip lies well above the middle line of the tegmen, and the most distal branch of R reaches almost to the apex. Anal area somewhat cultriform, well-defined, with some at least of the anal veins forking well before their distal ends.

Genotype, *Triassoblatta typica*, n.sp. (Upper Triassic, Ipswich, Q.).

This genus is closely related to *Rhipidoblattina* Handl., from the English Lias, but may be at once distinguished from it by the greater breadth of the tegmen in comparison with its length, and by the absence of intercalated veins and cross-veins.

The two species that can be placed with certainty in this genus may be distinguished as follows : –

Large tegmen (more than 20 mm. long) with definitely strengthened margin to humeral area. Sc with eight branches to border. Anal area with an irregular archedictyon ..... *T. insignita*, n.sp.

Medium-sized tegmen (about 12 mm. long) with humeral area normal, much narrower than in the above. Sc with only four branches to border. Anal area without any reticulation ..... *T. typica* n.sp.

Text-fig.31.

Triassoblatta typica, n.g. et sp. (×7½). Left and right tegmina *in situ*. Upper Trias of Ipswich, Q. Drawn from Specimen No.180*a*.

TRIASSOBLATTA TYPICA, n.sp. (Text-figs.30*a*, 31).

This specimen is a *mould** of both tegmina *in situ*, the right one almost complete, the left with portions of the costal and

* The impression is a very flat one, but the *vena dividens* lies upon a ridge, thus proving that the fossil is a *mould*, not a *cast*. Consequently left and right sides are interchanged, as in the figure. Dr. Shaw writes : —"Almost invariably in Cockroaches the left tegmen overlaps the right."

posterior borders missing. The apices of both tegmina are also missing. The left tegmen overlaps the right; but, in process of delamination, its extreme posterior border has broken away, leaving somewhat more of the corresponding border of the right tegmen exposed than would otherwise have been the case. Most of the anal area of the right tegmen is well preserved, but the posterior border is missing, as well as, apparently, the whole of this same area in the left tegmen.

Judging from the form of the impression, the insect must have been of considerably broader build than is usually found in existing winged forms amongst Australian cockroaches, even if we allow something for flattening down during fossilisation.

Greatest length of fossil, 11·5 mm., representing a tegmen whose *total length* was about 12 mm. *Greatest breadth*, 5·8 mm., representing a total breadth across the two tegmina *in situ* of about 7 mm., and a probable greatest width for a single tegmen of 4·5 mm.

Humeral area narrow, 3·4 mm. long from base to apex, bounded distally by a simple, nearly straight branch of Sc. Distad from this, Sc gives off another sector, which branches into three. Sc, R and its branches are strongly-formed, moderately thick veins. R sends in all seven primary branches towards the anterior border, excluding the distal forked end of the main stem; of these, the first is a forked vein, the second simple, the third forked, the fourth a long vein with four branches, the fifth also a long vein with three branches, the sixth simple, the seventh short with three branches. (This description applies to the right tegmen only; the distribution of the branches in the left tegmen, as far as these are preserved, is somewhat different). Media a moderately strong vein, branching dichotomously again and again, and sending at least nine branches to the wing border at and below the apex. Cubitus also a moderately strong vein, dichotomously branched, sending six veins to the posterior border. *Vena dividens* strongly arched, deeply impressed. Anal area just over 5 mm. long from base to apex, greatest breadth about 3 mm. Of the anal veins the first (most anterior) lies close to the *vena dividens*, and ends up distally upon it; all the

rest apparently end upon the posterior margin of the wing. Second and third anal veins simple, the fourth forking about midway, with an extra distal fork on the anterior branch. The other anal veins not fully preserved, but some of them are evidently forked. Distance between first and second anal veins much greater than that between the others.

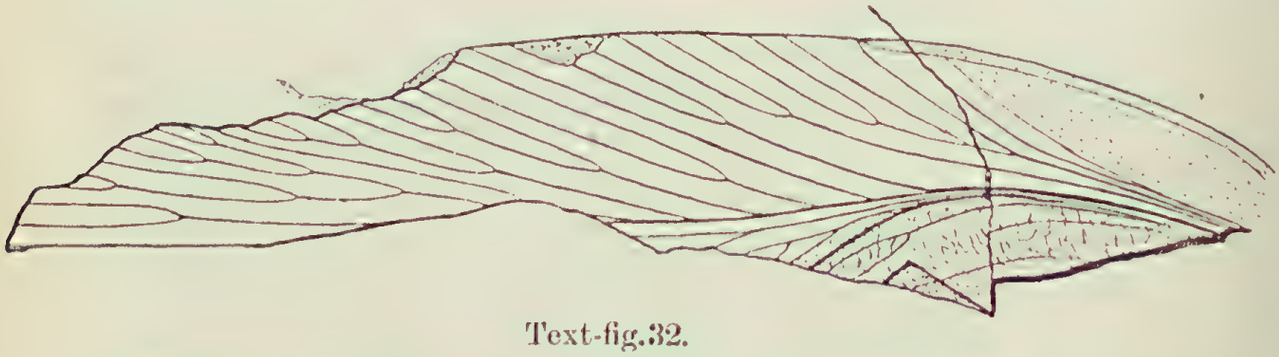
Type, Specimen No.180*a*, with its counterpart No.180*b* (the latter shows only about the basal two-fifths of the tegmina). (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

TRIASSOBLATTA INSIGNITA, n.sp. (Text-fig.32).

A fragment of a single left tegmen, including almost the whole of the anterior portion from base to apex, with humeral area, Sc and most of R, also the bases of M and Cu, more than half of the *vena dividens*, and the upper portion of the anal area.

Greatest length, 19·5 mm., representing a total length for the tegmen of about 21 mm. *Greatest breadth* of fragment, 4 mm., representing an estimated total width of tegmen about 8·5 mm.



Text-fig.32.

Triassoblatta insignita, n.g. et sp. (×5·4). Fragment of left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No.124.

Humeral area 6 mm. long from base to apex, moderately wide, and having its anterior or costal border strongly thickened; this thickening extends as far as the *third* branch of Sc. First two branches of Sc simple; distad from these follows a long sector giving off four branches; beyond this is another forked sector, so that the total number of branches sent by Sc to the wing-border is eight. Radius apparently gives off six primary branches to the anterior border, exclusive of the forked end of the main stem. Of these, the first is a forked vein, the second simple, the

third again forked, the fourth with three branches, the fifth with four, and the sixth a many-branched vein sending altogether no less than eight branches to the margin of the wing. M and Cu are forked near their bases. *Vena dividens* strongly marked. Anal area, as far as preserved, covered with an archedictyon or primitive palæodictyopterous meshwork of weak, irregular veinlets; the first anal vein lies close to the *vena dividens*, and probably meets it distally; this vein also forks at about half-way; second and third anal veins, as far as preserved, appear to be simple and moderately wide apart.

Type, Specimen No.124. (Coll. Queensland Geological Survey).

Horizon: Upper Trias, Ipswich, Q.

In spite of the fragmentary nature of this fossil, there can be little doubt that it belongs to the genus *Triassoblatta*, since the characters of the costal area, subcosta, and radius agree with the definition, while enough of the anal area is preserved to show that it must have been of considerably greater length, from base to apex, than the completely preserved humeral area.

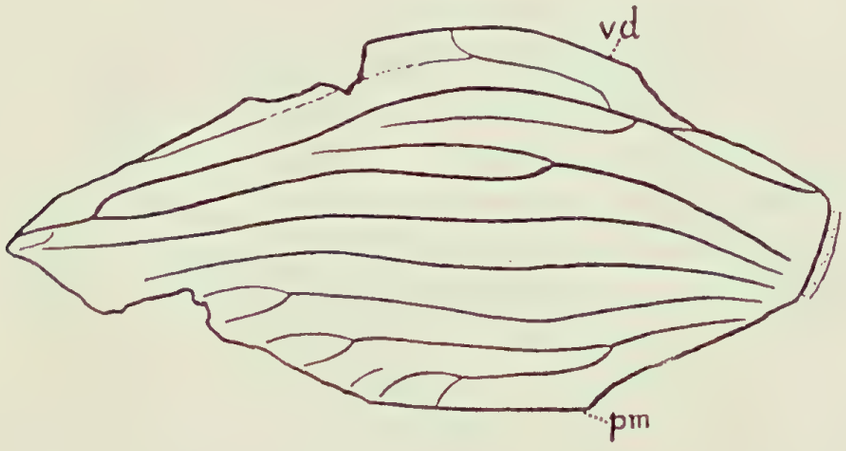
TRIASSOBLATTA(?) INTERMEDIA, n.sp. (Text-fig.33).

This species is represented only by the anal area of a left tegmen, which is almost complete. It may be placed provisionally in this genus, on account of the forking of some of the anal veins, a character shared in common with the two species already described, but absent from the other genera defined in this paper.

Total length of anal area, 7·3 mm. *Greatest breadth*, 3·3 mm.

Most of the *vena dividens* missing, but the more anterior part of it (*vd*) preserved. The first anal vein appears to be the weakly formed vein lying just below the *vena dividens*, and connected both with it and with the second anal vein. The latter is a very strong vein, much curved, giving off a posterior branch which does not connect up with any other vein, and anastomosing, near its distal end, with the third anal. The third anal is also a strong vein, giving off an anterior branch which, like the very similar posterior branch of the second anal vein, does not

connect up with any other vein. The fourth and fifth anals are unbranched and nearly straight; the sixth a weaker vein, slightly curved, and with a short distal fork. The seventh is a weak vein, branching into two not far from its base; each branch forks again near its distal end. The fused distal ends of the second and third anal veins appear to end up almost exactly upon the apex of the area; all the veins below these end upon the posterior margin (*pm*). Traces of a true archedictyon are evident in this fossil, but have been omitted from the drawing in Text-fig. 33.



Text-fig. 33.

Triassoblatta(?) *intermedia*, n.sp. (× 11). Left tegmen, anal area. Upper Trias of Ipswich, Q. Drawn from Specimen No. 216.

Type, Specimen No. 216. (Coll. Queensland Geological Survey).

Horizon: Upper Trias, Ipswich, Q.

The anal area described above is intermediate in size between those of *T. typica*, n.sp., and *T. insignita*, n.sp., and probably belonged to a tegmen about 18 mm. in length. In showing traces of an archedictyon, it comes closest to the anal area of *T. insignita*. The arrangement and branching of the anal veins is very distinct, and should alone enable us to recognise the species again, if by any chance a more completely preserved specimen be one day found.

Genus SAMAROBLATTA, n.g. (Text-figs. 30*b*, 34-38).

Medium-sized tegmina (about 13 or 14 mm. in length). Humeral area moderately wide, of about the same length, from base to apex, as the anal area. Sc a single, strong, and nearly straight vein bounding the humeral area distally, with or without a weaker, incomplete branch vein proceeding from it on to the humeral area. Main stem of R with fairly strong double-curving, so that its lowest point of dip lies almost upon the middle line of the tegmen, and the most distal portion of R reaches the border well before the apex. Anal area somewhat cultriform, well-defined; forkings of anal veins, if any, confined to small twigs near their distal ends.

Genotype, *Samaroblatta reticulata*, n.sp. (Upper Trias, Ipswich, Q.).

Closely related, by the character of the strong double-curving of R, to *Mesoblattula* Handl., from the Lias of Dobbertin, Mecklenburg; but at once distinguished from it by its much greater size and larger number of veins. The generic name is derived from the word *samara* (Lat. *samera* or *samara*, the seed of the ash), a botanical term indicating the winged mericarp found in the Natural Order Aceraceæ, such as the seed of the maple, sycamore, etc. The appearance of these fossil tegmina, with their strongly impressed basal anal area, is strongly suggestive of this type of winged seed. Parenthetically, it may be mentioned that the venation of quite a number of plant-remains is deceptively like that of the cockroach tegmen, necessitating some care on the part of the investigator of these fossils.

This genus differs from *Triassoblatta*, n.g., not only in the greater comparative length of its humeral area (as given in the key), but also by the simplification of Sc, the much greater double-curving of R, and the absence of any but small distal forkings from the anal veins.

The five species here described may be separated by the following key :—

(1) { Sc, R and its branches strongly thickened veins; M and Cu moderate .... *S. blabelloïdes*, n.sp.
{ All the veins slender ..... 2.

(2) All the veins, except those of the anal area, separated from one another by broad, strongly developed ridges, resembling thickened veins, but distinguished by not being joined to one another basally ..... 3.
M, Cu and their branches separated by delicate intercalated veins .... *S. intercalata*, n.sp.

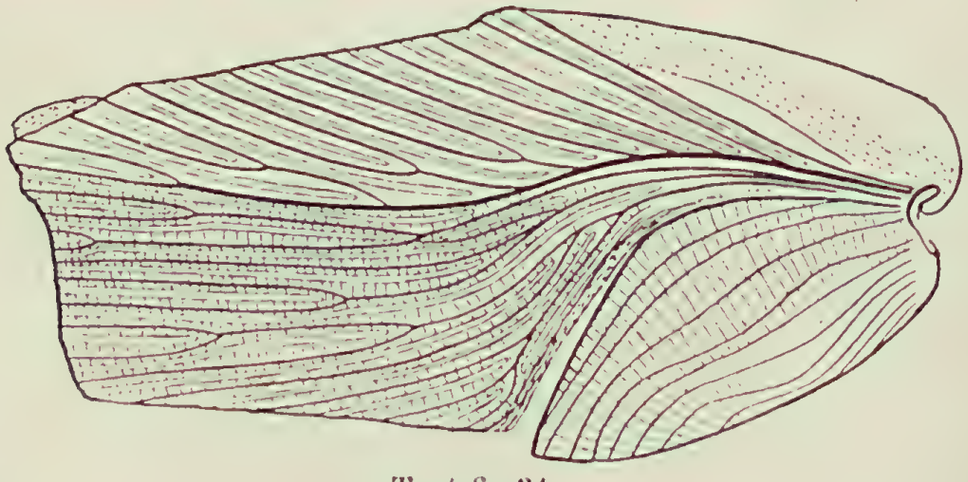
(3) Delicate cross-venation indicated on M, Cu and anal areas... ..... *S. reticulata*, n.sp.
No cross-venation on these areas ... . 4.

(4) Anal veins distinct, the third, fourth, and fifth with small distal forkings; delicate cross-venation indicated in region of branches of R ..... *S. triassica*, n.sp.
Anal area with only vestiges of veins; no cross-venation indicated anywhere on the tegmen .... *S. jonesi*, n.sp.

SAMAROBLATTA RETICULATA, n.sp. (Text-figs.30*b*, 34).

A beautifully preserved left tegmen, complete except for a narrow portion missing from the anterior border, and the whole of the apical portion. Anal area complete, but slightly torn away from the rest of the tegmen along the *vena dividens*.

Greatest length, nearly 10·5 mm. *Greatest width*, 4·5 mm. Probable *total length* of tegmen, nearly 14 mm.



Text-fig.34.

Samaroblatta reticulata, n.g. et sp. (×7½). Left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No.155*a*.

Extreme base of tegmen well preserved, showing the typical Blattoid humeral border, strongly convex. Humeral area 5·5 mm. long, sharply pointed at apex, and carrying a single weakly indicated branch from Sc. Main stem of R giving off seven

primary branches to the anterior border, excluding the forked distal end; of these, the first four are simple veins, the fifth, sixth, and seventh forked. M sends at least seven branches to the apex and below it. Cu sends also at least seven branches to the posterior border; of these the more anterior ones extend far out below the apex, parallel with the lower branches of M. In the area covered by M and Cu, there are strong indications of a somewhat irregular cross-venation.

Raised ridges of considerable breadth separate all the veins, except those on the anal area. These ridges appear at first sight to be the veins themselves; but a closer examination shows that they do not join up basally with one another, whereas the finer veins lying between them do all so join up. Thus these latter must be the true veins, the ridges being probably some specialised development of a series of intercalated veins. The cross-venation, where it is well enough preserved to be studied with advantage, can be seen to lie on either side of each true vein, being interrupted more or less by the intercalated ridges.

Anal area complete, with *vena dividens* strongly marked. Anal veins weakly indicated anteriorly, more strongly posteriorly. A fairly regular cross-venation present almost all over the anal area. First anal vein both arising from and ending upon the *vena dividens*; the second lying close below the first, but ending just below the apex; the third and fourth wide apart, the latter much waved; the fifth close under the fourth, much less curved; below this are five more veins, the first two of which are considerably waved.

Type, Specimen No.155*a*. (Coll. Queensland Geological Survey).

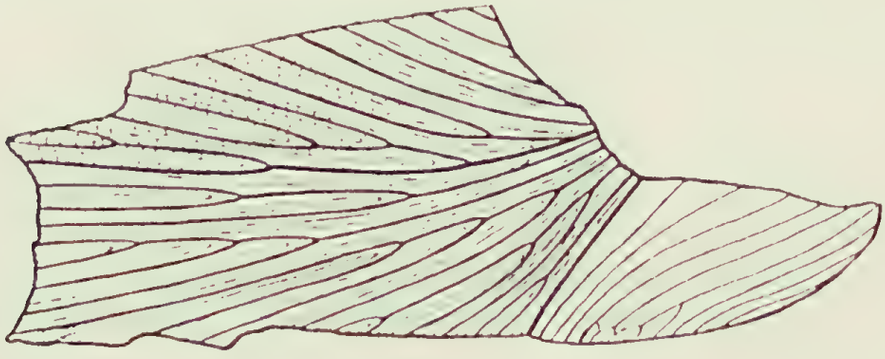
Horizon: Upper Triassic, Ipswich, Q.

SAMAROBLATTA TRIASSICA, n.sp. (Text-fig.35).

A well preserved fragment of a left tegmen, with the greater portion of the base missing, also the apex and a narrow piece along the posterior border.

Greatest length, 10·5 mm., representing a tegmen whose total length was about 13 mm. *Greatest breadth*, 4·5 mm.

Closely similar to *S. reticulata*, from which it differs as follows:—Branchings of R, M, and Cu differently arranged, as may be seen by comparing Text-figs. 34 and 35. (Not much stress can be laid on this character, however, since not only different individuals of the same species of Cockroach, but also even the right



Text-fig. 35.

Samaroblatta triassica, n.g. et sp. (×7½). Left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No. 156.

and left tegmina of the same individual, show considerable differences in this respect). Cross-venation indicated upon the area served by the branches of R, but not upon M, Cu, or the anal area. Anal area with nine anal veins, all ending upon the posterior border; the fourth, fifth, and sixth with small distal forkings, which anastomose with one another; the other anal veins simple.

Type, Specimen No. 156. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

Though the costal area is missing, the structure of R shows that this species belongs to the genus *Samaroblatta*.

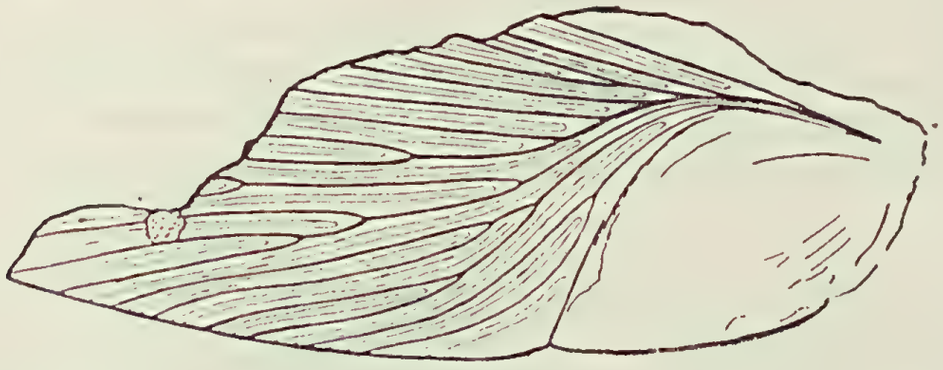
SAMAROBLATTA JONESI, n.sp. (Text-fig. 36).

A fairly well preserved fragment of a left tegmen, with the costal border and apical area missing, most of the posterior border and anal area complete.

Greatest length, 11 mm., indicating a tegmen of total length about 13 mm. *Greatest breadth*, 4 mm.

Closely related to the above two species, but distinguished from them as follows:—No cross-venation anywhere indicated;

anal area with only vestiges of anal veins. The veins and intercalated ridges are well preserved, and the form of branching of R, M, and Cu is not unlike that of *S. reticulata*, n.sp. But M had certainly less than seven branches, while Cu, which is completely preserved in this fossil, shows only six.



Text-fig.36.

Samaroblatta jonesi, n.g. et sp. (×7½). Left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No.157*a*.

Type, Specimens No. 157*a*, 157*b* (part and counterpart). (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

Dedicated to Mr. A. J. Jones, the present Minister for Mines in Queensland.

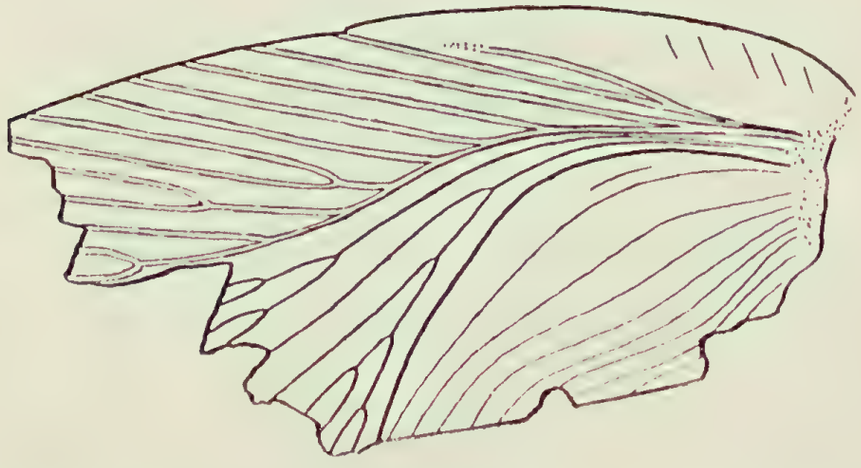
SAMAROBLATTA BLABELLOIDES, n.sp. (Text-fig.37).

A well preserved fragment of a left tegmen, with the apical third missing, broken off along a very irregular line. There are also small portions missing from the anal area and extreme base.

Greatest length of fragment, 9·3 mm., indicating a tegmen of total length 13 mm. *Greatest breadth*, 5 mm., being the total breadth of the tegmen.

Costal area fairly wide, sharply pointed at apex, 6 mm in length from base to apex; bounded distally by the straight vein Sc, from which a less distinct branch comes off within the area; slight signs of a series of oblique costal veinlets towards the base. Sc, R and its branches consisting of very thick veins; M and Cu only moderate. Primary branches of R seven, excluding the forked end of the main stem; the first four straight, simple

veins, the fifth forked near its base, the sixth forked further distad, the seventh only partly preserved. So far as preserved, M shows four branches, Cu six. No signs of intercalated veins or cross-veins. Anal area well defined, with strongly marked *vena dividens*, and anal veins unbranched. What is probably the first anal vein is only just indicated by a slight impression near the top of the area; then follow two widely spaced veins, corresponding exactly with the second and third anal veins of *S. reticulata*, n.sp.; below these are about six more veins, closer together, and not quite so irregularly curved as in *S. reticulata*.



Text-fig.37.

Samaroblatta blabelloïdes, n.g. et sp. (×7½). Left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No.131*b*.

Type, Specimen No. 131*b*. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

In spite of the difference in the structure of the veins in the region of Sc and R, and the absence of intercalated veins and cross-veins, this species would appear to be closely allied to *S. reticulata*. As far as it is preserved, the branching of R is closely similar in the two species, while the arrangement of the anal veins shows also a very close parallelism.

The specific name has been given on account of the thickened veins in the anterior region of the tegmen, reminding one of the similar condition in the well known genus of recent cockroaches, *Blabella* Caudell (=*Phyllodromia* Serville, preoccupied), of

which the common *B. germanica* (Linn.) is the genotype. A similar condition also exists in the very fragmentary Mesozoic fossil *Pachyneuroblattina rigida* Handl. (1, p.433), in which also the primary branches of R, as far as preserved, exactly correspond with those of our new species. It seems a pity that Handlirsch should have founded a new genus on such a fragmentary type as this, especially as the thickening of the veins may not really be of generic value at all, any more than it is in *Samaroblatta*. Until a more complete specimen is found, it would not be possible to decide the amount of relationship between *Pachyneuroblattina* and *Samaroblatta*.

SAMAROBLATTA INTERCALATA, n.sp. (Text-fig.38).

Greatest length of fragment, 10 mm.; *greatest breadth*, 3·3 mm. A fragment of a left tegmen of probably about the average size of those already described in this genus.

Text-fig.38.

Samaroblatta intercalata, n.sp. (×7½). Left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No.262.

The anal area is missing, and the costal area not clearly preserved, except for a small portion of the costal border. The double-curving of R is strong, and is the one definite character that allows of the species being placed in the genus *Samaroblatta*. The limits of Sc and R basally are not clear; what appears to be the first primary branch of R is itself three-branched, a very unusual condition for *Samaroblatta*. The next branch of R is forked, then follow in order two simple branches, a forked branch, another simple branch and a final branch making a very definite fork with the main stem; thus there are seven primary

branches of R in all, as far as preserved. The veins below R appear at first sight to be very well preserved, but it is not possible to determine the more basal portions of M and Cu with certainty. Intercalated veins are quite absent in the region of R, but are present between every pair of veins in the regions of M and Cu, and are very clearly marked. This character has suggested the specific name.

Type, Specimen No. 262. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

Genus AUSTROBLATTULA, n.g. (Text-fig.39).

Small tegmina (less than 10 mm. long), with the humeral area, if anything, slightly longer from base to apex than is the anal area. Sc apparently fused with R basally, and consisting of a single, straight vein bordering the humeral area distally. R bent near base, then almost straight for most of its length, curving slightly upwards towards the apex. Anal area somewhat cultriform, more than usually broad; the anal veins apparently unforked (indistinctly preserved).

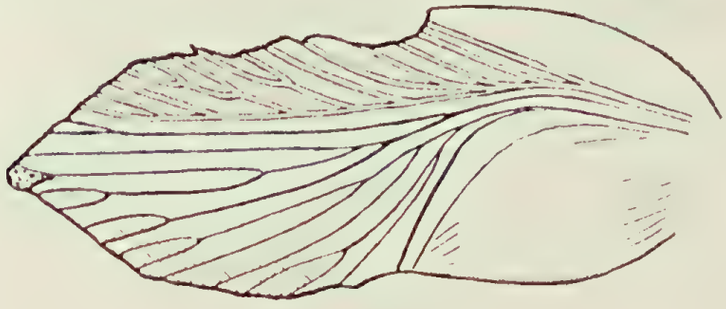
Genotype, *Austroblattula ipsviciensis*, n.sp. (Upper Trias of Ipswich, Q.).

This genus comes fairly close to *Mesoblattina* Geinitz, from the Lias of Dobbertin, Mecklenburg, but may be distinguished from it by its larger humeral area, not crossed by any branch of Sc, by its broader anal area, and by the absence of intercalated veins. From *Mesoblattula* Handl., another genus of small cockroaches from the same beds, it can be at once separated by the absence of the strong double-curving of R, as well as by its larger humeral and anal areas, and by the absence of intercalated veins. It agrees with *Triassoblatta* in lacking this strong double-curving of R, but differs from that genus in its much larger humeral area (in comparison with its size), its strongly reduced Sc, its much more strongly curved *vena dividens*, and its much smaller size. The differences between it and *Samaroblatta*, apart from its size, are indicated in the generic key already given.

AUSTROBLATTULA IPSVICIENSIS, n.sp. (Text-fig.38).

A small left tegmen with the whole of the basal portion preserved, but parts of the anterior, apical, and posterior margins missing.

Greatest length of fragment, 7·5 mm., indicating a tegmen of total length about 9 mm. *Greatest breadth*, 3·3 mm.



Text-fig.39.

Austroblattula ipsviciensis, n.g. et sp. (×7½). Left tegmen. Upper Trias of Ipswich, Q. Drawn from Specimen No.105*a*.

Humeral area of moderate width, without veins or markings of any kind. Sc a straight, simple vein, bounding the humeral area distally. Main stem of R giving off eight primary branches, exclusive of its apical continuation; of these the first two are simple veins, the third forked near its base, the fourth simple, the fifth forked, the sixth three-branched, the seventh and eighth simple (as far as preserved). Sc, R and its branches are formed of strong, thick veins, as in *Samaroblatta blabelloïdes*, n.sp.; M and Cu are only moderately strong veins, each of which gives off seven branches to the wing-border. *Vena dividens* very strongly arched; the first anal vein complete, simple, ending on the posterior border just below the apex of the area; the other anal veins only partially indicated towards their bases and apices.

Type, Specimens No. 105*a*, 105*b* (part and counterpart). (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

BLATTOIDEA INCERTÆ SEDIS.

Specimen No.152 (Text-fig.40). A fragment of a cockroach tegmen, about 8 mm. long, and showing very clearly a number of branching veins, and apparently also the outline of the costal

border of the humeral area above them. If the most anterior of the preserved veins be Sc, as appears very likely, then this fossil must belong to a more archaic group than the *Mesoblattinidæ*, seeing that Sc appears to have retained its primitive branched condition and has remained of considerable length. The affinities of this specimen are quite uncertain, and it does not seem to me to be complete enough to merit a name.

Text-fig.40.
Specimen No.152 (× 7½).

Specimens No.121a, 121b (part and counterpart). These represent fragments of a cockroach tegmen, very indistinctly preserved, and not well enough characterised to merit a name. The basal half or more of the tegmen is shown, with most of the anal area. The venation is indistinct, except for Sc and some of the branches of R, which appear to be thick, strongly formed veins. Length, 6 mm.; greatest breadth, 3 mm.

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From the Proceedings of the Linnean Society of New South Wales, 1919, Vol. xliv., Part 4, 26th November, 1919.

MESOZOIC INSECTS OF QUEENSLAND.

No. 7. Hemiptera Homoptera; with a Note on the Phylogeny of the Suborder.

By R. J. Tillyard, M.A., D.Sc., F.L.S., F.E.S., Linnean Macleay Fellow of the Society in Zoology.

(With Twenty-four Text-figures.)

The first collection of fossil insects made by Mr. Dunstan at Ipswich contained only a single Hemipteron belonging to the Suborder Homoptera. This specimen I named *Mesojassus ipsviciensis* (8, p. 35, Pl. 2, fig. 7), placing it in the family *Jassidae*. In the two consignments following, no less than twenty-two specimens of Homoptera are represented, some of them in a very perfect state of preservation. Thus this group now becomes next in importance to the Coleoptera, as regards its numerical preponderance in the Ipswich Insect Fauna; and the working out of the material has been a matter of considerable interest on this account, as well as on account of the beauty and remarkable preservation of some of the forms.

In writing this paper, I have been fortunate in having had the advice and criticism of Mr. F. Muir, F.E.S., of Honolulu. Mr. Muir is a recognised authority upon the Homoptera, and I desire to thank him for reading the MS. and offering some valuable criticisms.

All the material consists of tegmina, either whole or in fragments. The toughness of the Homopterous tegmen renders it, like the elytron of the Coleoptera, particularly suitable for preservation in the fossil state; whereas the hindwing is, in most families, so delicate that it is not surprising that it is seldom found. Further, owing to the fact that the tegmen is divided obliquely by a deeply impressed furrow along the vein Cu_2, it is particularly liable to split along this vein; so that many of the fossils consist either of the main portion of the wing lying an-

terior to this furrow, or only of the *clavus,* or anal area, lying posterior to it. This clavus is only a small part of the wing, with nothing but the anal veins preserved upon it; and yet, as we shall see in the course of this paper, every clavus discovered by itself should be preserved and described, because there is on the clavus, at least one character of great importance for the correct classification of the fossil forms.

The oldest known Homoptera are three forms from the Upper Permian, viz. *Scytinoptera kokeni* Handl. (3, p. 392) from the Kama River, Russia, *Permoscarta mitchelli* Till. (9, p. 728) from Newcastle, N.S.W., and *Permofulgor belmontensis* Till. (9, p. 731) from Belmont, near Newcastle, N.S.W. Handlirsch places *Scytinoptera* in a distinct Order Palæohemiptera; but I have already expressed my opinion that this is nothing more nor less than a true Homopteron (10, p. 587). *Permofulgor,* as a very distinct type unlike anything existing to-day, was put into a new family *Permofulgoridae. Permoscarta* I placed in the *Cercopidae;* but, on maturer consideration, I think it should be removed to the *Scytinopteridae.*

From the Upper Trias only two Homoptera are so far known. One of these is *Mesojassus ipsviciensis* Till., already mentioned; the other *Triassopsylla plecioides* Till. (9, p. 754) from the Wianamatta Shale of Glenlee, N.S.W.

Handlirsch lists no less than twenty-two species of Homoptera from the Lias, and there are undoubtedly others from various localities in England, which have not been properly described as yet. The named species come from England, Switzerland and Germany, the most prolific locality being Dobbertin in Mecklenburg, with seventeen species. They are placed as follows:—*Fulgoridae,* 4 genera, 13 species; *Procercopidae,* 1 genus, 3 species; *Jassidae,* 1 genus, 5 species; *Archipsyllidae,* 1 genus, 1 species.

Thus it will be seen that the Ipswich beds have already yielded an Homopterous fauna as rich as any yet found in the Palaeozoic or Mesozoic epochs; and it may reasonably be hoped that many more may be discovered later on. That being so, it is of especial importance that these fossils should be most carefully studied, in the hopes that they may throw some light upon the Phylogeny of the Homoptera.

Here we meet with the initial difficulty that the classification of the Homoptera is based for the most part upon characters

other than the wing-venation; such as, for instance, the number and position of the ocelli, the form of the legs and prothorax, and the shape of the head. Recent studies of the nymphal tracheation in the various families have much improved our knowledge of the venation, but they have not yielded a really satisfactory basis of classification on venational characters only.

In this connection, I should like to point out that the vein which has been interpreted by Comstock and his school (1, 2, 4, 5, 6) as 1A in the Homoptera is certainly not that vein, but Cu_2. Its precedent trachea comes off from Cu, not far from its origin, in all families of the Homoptera, and in all instars in which the wing-sheaths are developed far enough for examination. This condition is exactly parallel with that to be found in all instars of the Cockroaches, in which I have recently satisfied myself that the *vena dividens*, or concave vein separating the anal area from the rest of the wing, is undoubtedly Cu_2; and, as this vein also borders the clavus or anal area in the Homoptera, there is no longer any need for a far-fetched attempt to name it 1A, by trying to explain that its trachea has become fused with Cu. The condition shown in the Homoptera and the Cockroaches is also exactly the same as that seen in the Panorpoid Orders, in which I have already shown (11) that Comstock makes the same mistake in working out the venation of the Trichoptera and Lepidoptera, though he has got the names of the veins right in the Megaloptera, and thereby himself admitted his error in the other Orders. I have also, finally, studied the venation in all examinable stages of the Psocoptera, in which this same condition is also to be found. The only conclusion to be come to is that the cubitus in all these groups is normally three-branched, Cu_1 forking distally into Cu_{1a} and Cu_{1b}, while Cu_2 is a straight, concave vein, which, in those Orders which have a separate clavus, borders that area anteriorly. I have therefore marked the *vena dividens*, in all my figures, as Cu_2; in this respect, my nomenclature for the Homoptera differs from all the figures of the venation of this Order so far published except Muir's (7).

It follows from this that the veins on the clavus itself are 1A and 2A. Vein 3A is absent in all recent forms, but is clearly to be seen in the Permian genus *Permofulgor* (9), and in the Liassic genus *Archijassus* (3).

In working out the Ipswich fossil Homoptera, it is at once

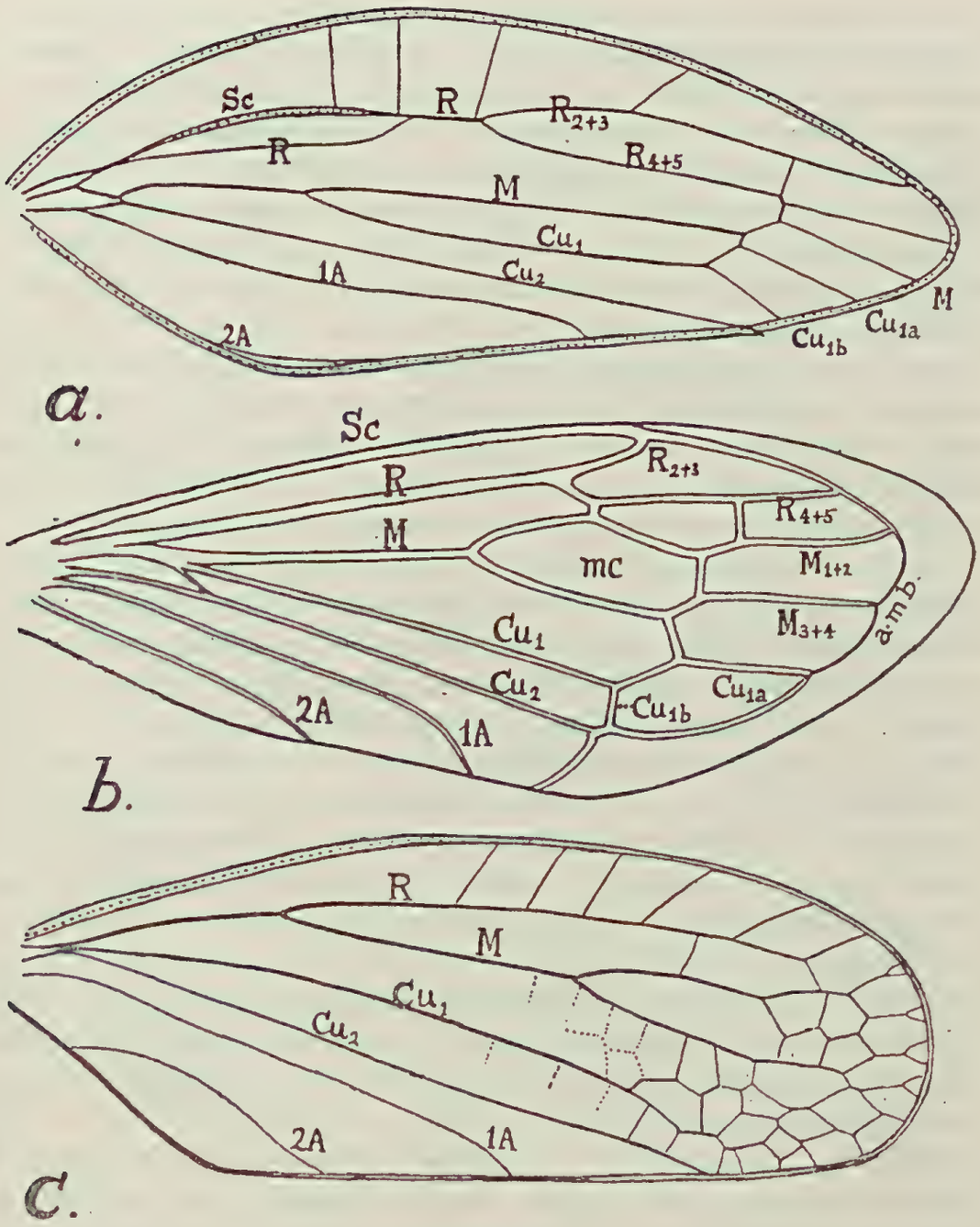
evident that they all belong to the division Auchenorrhyncha, comprising, at the present time, only the families *Cicadidae, Cercopidae, Jassidae, Membracidae* and the old family *Fulgoridae,* this last being now usually split up into seven or more families (Fulgoroidea). Further than this we may also say that the *Cicadidae* are not represented in the collection under review. Their type of venation is very distinct; and nothing approaching it has been found at Ipswich, with the single exception of the puzzling genus *Mesogereon,* which has been allotted a special part of this work to itself, seeing that it constitutes a very special problem involving the discussion of other Orders as well. There remain, then, only the other families of the Auchenorrhyncha in question; and hence we have to determine, as far as possible, what are the venational differences to be considered in separating one family from another, and thus in placing our fossils in their correct families.

First of all, the old family *Fulgoridae* contained, with very few exceptions, insects in which the clavus of the tegmen had the two veins 1A and 2A united together for a greater or less distance distally, to form a true Y-vein, of the same type that I have already discussed in the Lepidoptera (11). We may, then, take it that any Fulgoroid fossils would have this character. It is only present in a single genus of the fossils, viz. *Ipsvicia.* As these tegmina are very distinct from anything known at the present day, I have placed them together in a new family *Ipsviciidae,* belonging to the superfamily Fulgoroidea.

The *Cercopidae, Jassidae* and *Membracidae* all agree in having tegmina in which 1A and 2A remain apart from one another. This character is clearly shown in all the remaining tegmina in which the clavus is preserved. In separating the remaining fossils, therefore, we have to consider the venation of the rest of the tegmen more carefully.

In Text-fig. 1, I have shown the venation of an Australian genus *Cercopidae, Philagra* (*a*), of an Australian Membracid genus *Sertorius* (*b*), and an archaic Australian Jassid genus, *Eurymela* (*c*).

In all *Cercopidae* which I have seen, as in *Philagra* here figured, veins Sc and R are distinct and separate for a considerable distance basally, and then become united. We may take it, therefore, that this character should appear in any fossil tegmina that are to be considered true *Cercopidae.* As it is not present in



Text-fig. 1.

Venations of tegmina of recent *Cercopidae*, *Membracidae* and *Jassidae*. *a*, *Philagra* sp. *(Cercopidae)* from Mount Tambourine. Q. *b*, *Sertorius* sp. *(Membracidae)* from Jervis Bay, N.S.W. *c*, *Eurymela* sp. *(Jassidae)* from Gosford, N.S.W. For lettering see p.895.

any of our fossils, we may decide that they are not members of this family.

The *Jassidae* and *Membracidae* are very closely allied. The two families probably arose from a common stem, the *Mem-*

bracidae becoming specialised in the sculpture of the prothorax. The *Membracidae* are also specialised in certain aspects of their wing-venation, notably in the very distinct narrowing of the clavus, and in the development of a complete distal *ambient vein* (Text-fig 1 *b*, *amb.*), uniting the tips of R, M and Cu; with a definite clear wing-area, uncrossed by any veins, between it and the wing-margin. Neither of these characters, again, is to be found in any of our fossils; and therefore they are not to be considered as *Membracidae*.

Apart from the *Ipsviciidae*, already mentioned, all the fossil tegmina from Ipswich belong either to the *Jassidae*, or to some archaic family of Auchenorrhyncha not existing at the present day. The characters of the Jassid tegmen are sufficiently well shown by the genus *Eurymela* (Text-fig. 1 *c*). The clavus is, typically, fairly broad, in the form of an obtuse-angled triangle, separated from the rest of the wing by a very straight, and usually deeply impressed, vena dividens (Cu_2), and having the veins 1A and 2A lying upon it far apart, vein 2A being frequently waved. Sc is absent, or completely fused with R. R and M are fused together basally for some distance. The branchings of these two veins vary considerably, as may be seen by studying a number of different species of the genus *Eurymela*. Cu_1 is a straight, or nearly straight, vein running above and about parallel to Cu_2, and remaining unbranched until near its distal end.

Three of the Ipswich fossil tegmina agree with the *Jassidae* in all these points, and may therefore be placed definitely within that family. These are *Mesojassus* Till. (8), *Triassojassus* n.g., and *Eurymelidium* n.g.

There still remain over a number of tegmina which cannot be satisfactorily placed in any existing family. We have, therefore, to consider whether there are any known fossil forms with which they show affinity. The fossil forms already known in the Homoptera, which do not belong to existing families, are the Liassic family *Procercopidae* of Handlirsch, and the Permian genus *Scytinoptera* Handlirsch. The venation of the former is that of the true *Cercopidae*. Handlirsch only placed them in a separate family because he was of opinion that true *Cercopidae* could not have existed in the Lias. They may, therefore, be dismissed from the question. With respect to *Scytinoptera*, which comes from the Upper Permian of the Kama River, Rus-

sia, Handlirsch placed this fossil, together with the genus *Prosbole,* in a new Order Palaeohemiptera, and formed, for the reception of this single fossil, the new family *Scytinopteridae.* I have already discussed the genus *Prosbole* in connection with the Triassic *Dunstaniidae* from the Ipswich Beds, and have, in the same place, given it as my opinion that *Scytinoptera* is a true Homopteron (10). A survey of the new Ipswich Homoptera now shows that this opinion is correct. For there can be no doubt that the forms included in this part are true Homoptera, all of them having the tough, leathery consistency of the tegmen so frequently found in the Suborder, with distinct separation of a claval area along a straight vena dividens, and also definitely Homopteroid venations. And when we come to compare the venation of *Scytinoptera* with that of those Ipswich fossils which we have not so far been able to place, we are struck at once with the close similarity between this Permian genus and two of the Ipswich forms, which I have placed in a new genus *Mesoscytina.* These forms are undoubtedly closely related to *Scytinoptera,* and should go into the same family. I have, therefore, no hesitation in removing *Scytinoptera* from the Palaeohemiptera to the true Homoptera, and in constituting the family *Scytinopteridae* to contain the most archaic venational types of Homoptera yet discovered.

The *Scytinopteridae* are distinguished at once by the lack of fusion between R, M and Cu basally, there being instead, generally, a very peculiar formation at the base of these three veins, which is well shown in the genus *Scytinoptera* itself (Text-fig. 4). It would appear that three veins start out separately from the extreme base, and then come together again at a point a little further on. This same formation is to be seen in the *Ipsviciidae.*

Apart from this, the *Scytinopteridae* have the veins R, M and Cu separate, and diverging from one another from near the base outwards. In the original genus *Scytinoptera,* the clavus was not preserved. In one of the two species of *Mesoscytina,* n.g., described in this paper, a considerable portion of the claval area is preserved. From this we can see that the anal angle was somewhat rounded, not obtuse-angled as in the *Jassidae,* and that 1A and 2A are of very primitive form, and lie far apart from one another. In another new genus from Ipswich, *Mesodiphthera,* in which only the basal half of the tegmen is pre-

served, the whole of the clavus is present, showing complete agreement with that of *Mesoscytina,* as far as the latter is preserved. We may therefore place *Mesodiphthera* also in the *Scytinopteridae.*

Mesodiphthera n.g. differs from the rest of the *Scytinopteridae* so far mentioned, in that R branches into two at about the same level as the fork of M; whereas, in the other genera, R remains unbranched until near the apex of the wing. This gives us at once a connection with the Permian genus *Permoscarta* Till., (9, p. 727) from the Newcastle Beds. Originally, I placed this genus in the *Cercopidae;* but more mature study has convinced me that this type is far too generalised to go definitely into any existing family; and I now take the opportunity of removing it to the *Scytinopteridae,* as constituted in this paper. At the same time, we may reconsider the position of the genus *Permofulgor* (9, p. 730) from the Belmont Beds. For this genus, I made a new family *Permofulgoridae.* With the widening of the definition of the family *Scytinopteridae,* it is now evident that the *Permofulgoridae* are only a subfamily within that family; and, as Handlirsch's generic name *Scytinoptera* is older than my *Permofulgor* I now propose to sink the *Permofulgoridae* definitely to the status of a subfamily *Permofulgorinae,* within the *Scytinopteridae.*

It will thus be seen that all the known Permian Homoptera now go into the one family *Scytinopteridae;* and this affords additional proof, if such were now needed, of the Upper Permian age of the Upper Coal Measures of the Newcastle district.

Four more genera still remain to be placed, amongst the Ipswich fossils dealt with in this paper. Of these, *Chiliocycla* is a well defined genus, remarkable for the exceptionally strong and specialised tuberculation of the basal two-thirds of the wing. Its venation, so far as preserved, is closely allied to that of both *Scytinoptera* and *Mesoscytina,* and thus it may most certainly be placed within the *Scytinopteridae.* Another genus, *Triassoscarta,* n.g. shows distinct affinity with *Permoscarta* Till. from the Newcastle Beds, and, through this genus, with *Mesodiphthera;* this also can therefore be placed in the same family. The remaining two genera differ from all the rest in having three branches to R, and thus have a venation which, though definitely Scytinopterous in other respects, also resembles that of the *Cixiidae* amongst the Fulgoroidea. As, however, amongst the

many claval areas preserved at Ipswich, none but those of the highly specialised *Willcoxiidae* are of the Fulgoroid type, it would seem fairly certain that these two fossils may not be classed with the Fulgoroidea. They are better regarded as belonging to a separate subfamily of the *Scytinopteridae,* from which, perhaps, the *Cixiidae* arose later on, by specialisation of the veins of the clavus. I propose to name this subfamily the *Mesocixiinae,* from the name of the best preserved of the two genera, *Mesocixius,* n.g.; the other genus is *Triassocixius,* n.g.

We may now sum up the above results as follows:—

(1) In the Upper Permian, both in Russia and Australia, the first true Homoptera were present in the form of a single family having very primitive venational characters, viz. the *Scytinopteridae,* represented by the three genera *Scytinoptera* Handl. (Kama River, Russia), *Permoscarta* Till. (Newcastle, N.S.W.) and *Permofulgor* (Belmont, N.S.W.).

(2) In the Upper Trias of Ipswich, the *Scytinopteridae* were still the dominant family of Homoptera, being represented by no less than six genera. The *Ipsviciidae* were a highly specialised offshoot from this ancient family. Nothing like them is known elsewhere, either fossil or recent. Amongst recent families, the *Jassidae* were present at Ipswich, and represented by three genera. Other existing families were not represented at Ipswich, so far as known.

(3) In the Lias of the Northern Hemisphere, true *Scytinopteridae* appear to have become extinct. True Fulgoroids, Jassids and also Cercopids (Handlirsch's *Procercopidae*) were present.

It is interesting to note that, at Ipswich in the Upper Trias, the Homoptera formed nearly 20 per cent. of the total insect fauna, as preserved in the fossils, while at Belmont and Newcastle (calculated on a much smaller number of preserved forms) they formed 50 per cent. In the Lias, the Homoptera were only 6.6 per cent. of the total insect fauna. This percentage decreased to 4.5 in the Tertiary, and to 3.6 at the present day. The drop in the percentage from the Ipswich Trias to the Lias is due in part to the dying out of the *Scytinopteridae,* but more to the great rise in the representation of other Orders. If further evidence were needed of the approximate age of the Ipswich Beds, the percentage of Homoptera would place them definitely between the Upper Permian of Newcastle and the Lias of the Northern Hemisphere, but somewhat closer to the latter than to the former.

We may now proceed to the classification and description of the Ipswich fossil Homoptera. For this purpose, I offer first of all a list of the fossils, arranged in their families, and will then take each family in turn, and give keys to the subfamilies and genera included in it.

LIST OF THE FOSSIL HOMOPTERA FOUND AT IPSWICH.

Family SCYTINOPTERIDAE Handl.

Genus CHILIOCYCLA, n.g. (Genotype, *Ch. scolopoides*, n. sp.)
1. *Chiliocycla scolopoides*, n. sp. (p. 869).

Genus MESOSCYTINA, n.g. (Genotype, *M. australis*, n. sp.)
2. *Mesoscytina australis*, n. sp. (p. 871).
3. *Mesoscytina affinis*, n. sp. (p. 872).

Genus MESODIPHTHERA, n.g. (Genotype, *M. grandis*, n. sp.)
4. *Mesodiphthera grandis*, n. sp. (p. 873).

Genus TRIASSOSCARTA, n.g. (Genotype, *T. subcostalis*, n. sp.)
5. *Triassoscarta subcostalis*, n. sp. (p. 874).

Genus MESOCIXIUS, n.g. (Genotype, *M. triassicus*, n. sp.)
6. *Mesocixius triassicus*, n. sp. (p. 877).

Genus TRIASSOCIXIUS, n.g. (Genotype, *Tr. australicus*, n. sp.)
7. *Triassocixius australicus*, n. sp. (p. 878).

Family IPSVICIIDAE, fam. nov.

Genus IPSVICIA, n.g. (Genotype, *I. jonesi*, n. sp.)
8. *Ipsvicia jonesi*, n. sp. (p. 879).
9. *Ipsvicia maculata*, n. sp. (p. 881).
10. *Ipsvicia acutipennis*, n. sp. (p. 883).

Family JASSIDAE.

Genus EURYMELIDIUM, n.g. (Genotype, *E. australe*, n. sp.
11. *Eurymelidium australe*, n. sp. (p. 885).

Genus MESOJASSUS, Till. (Genotype, *M. ipsviciensis* Till.)
12. *Mesojassus ipsviciensis* Till. (p. 886).

Genus TRIASSOJASSUS, n.g. (Genotype, *Tr. proavitus*, n. sp.)
13. *Triassojassus proavitus*, n. sp. (p. 888).

Besides the above, there are five good impressions of Homopterous clavi, which I have decided to figure and describe, though they cannot be named.

There are also five other impressions of Homopterous tegmina which are too fragmentary or indistinct to be either described or figured. The total number of Homoptera so far found at Ipswich is therefore twenty-two specimens.

Family SCYTINOPTERIDAE Handl., a me emendata.

Primitive Homoptera belonging to the Upper Permian and Trias, in which the veins R, M and Cu come off separately from a point close to the base, and diverge from one another distad. Sc may or may not be present as a separate vein. M and Cu_1 are always forked, the former usually, the latter always towards the distal part of the wing. Condition of R very variable.

Clavus separated from rest of wing by a straight, deeply impressed vena dividens (Cu_2). Veins of the clavus (1A, 2A), standing far apart, 1A being waved, 2A very short, 3A usually absent. Anal angle rounded.

Tegmina of a tough, leathery consistency, finely tuberculated or pitted all over in most genera, but sometimes (*Chiliocycla*) armoured with large, closely-set, circular, flat tubercles, or quite smooth (*Permofulgor*).

Key to the Subfamilies and Genera of the family SCYTINOPTERIDAE.

(1)
- Tegmen very narrow and elongated, smooth; clavus with three separate veins upon it. ——————Subfam. PERMOFULGORINAE. (Only one genus, PERMOFULGOR Till. from the Upper Permian of Belmont, N.S.W.)
- Tegmen much broader in proportion, more or less tuberculated or pitted; clavus with only two separate anal veins, placed wide apart. ——————2.

(2)
- R with only two main branches, or not branched at all until near distal end. ——————Subfam. SCYTINOPTERINAE. 3. (Upper Permian and Upper Triassic).
- R dividing into at least three main branches (venation of distinct Cixiid type). ——————Subfam. MESOCIXIINAE. 8. (Upper Trias of Ipswich, Q.)

(3)
- Basal two-thirds or more of tegmen covered with large, flat, circular tubercles, closely set together. ——————CHILIOCYCLA, n.g.
- No such tubercles present on tegmen. ——————4.

(4)
- Area of tegmen between costa and R free of transverse veinlets from base to beyond half-way along the wing. ——————5.
- Area of tegmen between costa and R with a series of transverse veinlets beginning before half-way. ——————7.

(5)
- M remains unbranched except at its distal end. ——————SCYTINOPTERA Handl. (Upper Permian of Kama River, Russia).
- M branching into two at or before middle of wing. ——————6.

(6) { R remains unbranched until well beyond half-way along the wing. ——————MESOSCYTINA, n.g.
R branches into two slightly before the level of the branching of M. ——————MESODIPHTHERA, n.g.

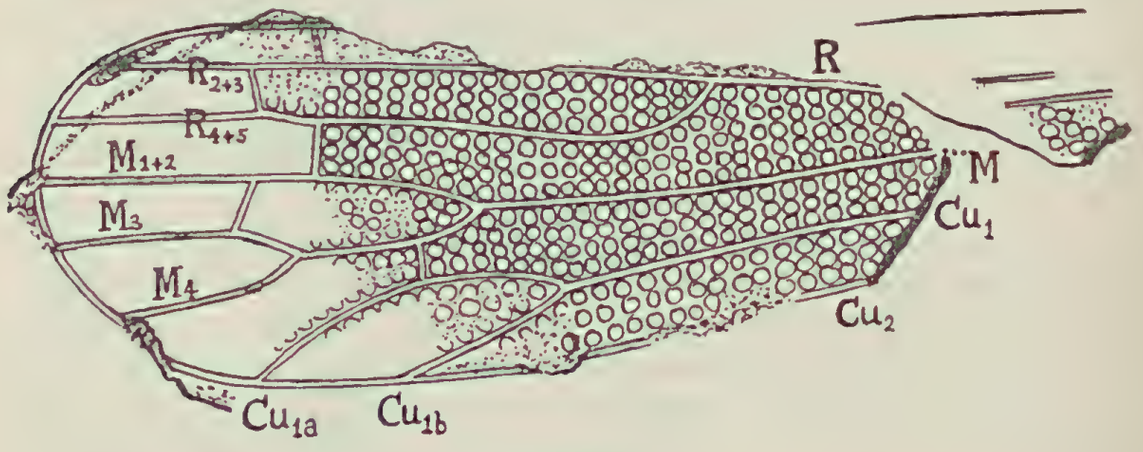
(7) { R unbranched; the series of veinlets between it and the costa extending from base to apex. ——————TRIASSOSCARTA, n.g.
R branched just before half-way; the veinlets between it and the costa beginning just beyond the dichotomy of R, and continuing to the apex, with a series of cross-veins beneath them, between the two branches of R. ——————PERMOSCARTA Till.
(Upper Permian of Newcastle, N.S.W.)

(8) { First dichotomy of R placed closer to the origin of R from M than to the second dichotomy of R; only two veinlets from the most anterior branch of R to the costa. ——————MESOCIXIUS, n.g.
First dichotomy of R much closer to second dichotomy than to the origin of R; a series of parallel veinlets from the most anterior branch of R to the costa. ——————TRIASSOCIXIUS, n.g.

Subfamily SCYTINOPTERINAE.

Genus CHILIOCYCLA, n.g. (Text-fig. 2).

Basal two-thirds or more of the tegmen covered with a remarkably strong sculpture of small, flat, circular tubercles set closely together. R with a single posterior branch arising a little before half-way; this branch connected to M_{1+2} by a single cross-vein above the median cell. M branches dichotomously at a level only slightly nearer to the base than the apical end of the clavus; the lower branch of M again divides, and the median cell is closed by a cross-vein from M_{1+2} to M_3. Cu_1



Text-fig.2.
Chiliocycla scolopoides, n.g. et sp. (x 15). For lettering see p.895.

a straight vein with a strong distal fork; a cross-vein connects Cu_{1a} with the median cell above it. (Clavus not preserved).

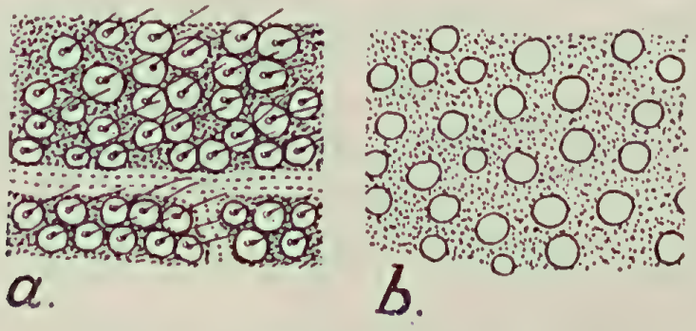
Genotype, *Chiliocycla scolopoides*, n.sp. (Upper Triassic, Ipswich, Q.)

This genus is evidently allied to *Scytinoptera* Handl., but differs from it not only in the remarkable sculpture of the tegmen, but also in the form of the posterior branch of R, which is longer and straighter, the very definite branching of M, with the formation of a definite median cell, and the stronger forking of Cu.

CHILIOCYCLA SCOLOPOIDES, n.sp. (Text-fig. 2).

Total length of preserved portion of tegmen, 6.4 mm., representing a tegmen of about 8 mm. *Greatest breadth*, 2 mm.

The area of strong tuberculation extends from the base outwards to about the level of the apical end of the clavus, with indications of some tubercles along the veins slightly distad from that level. Examined under a fairly high power, the tubercles are seen to be flat and circular, very closely and regularly arranged, there being three rows of them between the two branches of R, three rows between the posterior branch of R and M, three or four rows between M and Cu_1, and three rows between Cu_1 and the vena dividens (Cu_2) which is mostly obliterated in the fossil. Each tubercle is distinctly raised up above the level of the membrane surrounding it. On most of the tubercles there can be made out, situated at or near the centre of the circle, the impression of a socket of a hair or macrotrichia. Tubercles of this kind are not uncommon on the tegmina of existing Homoptera, as, for example, on many *Membracidae*, and in the Cercopid genus *Philagra*, but they are seldom developed over so large an



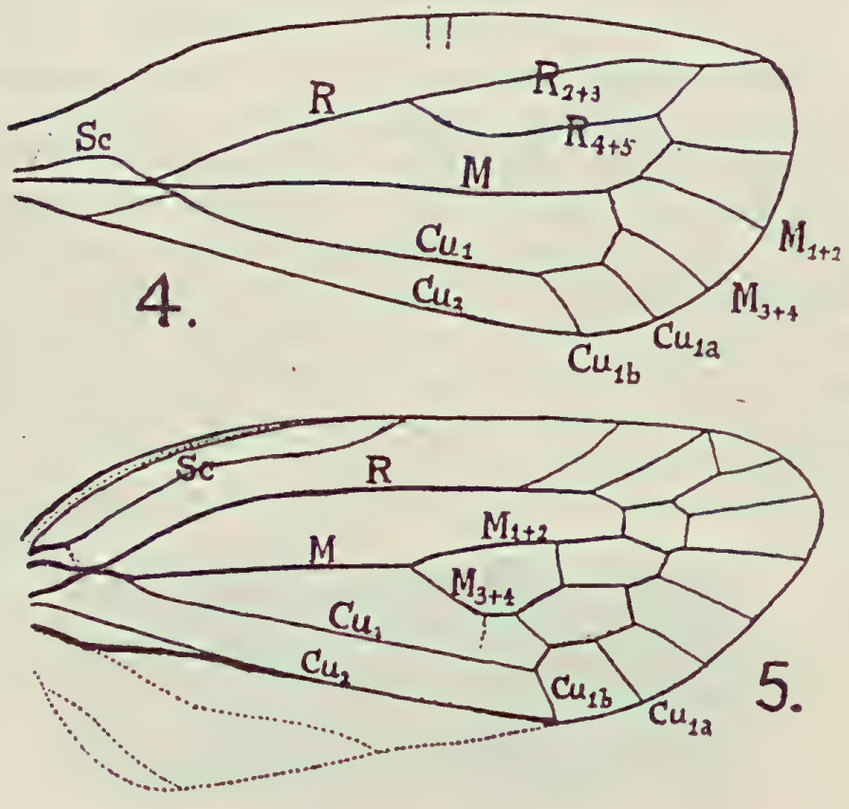
Text-fig. 3.

Two small areas from the tegmen of *Philagra* sp. *(Cercopidae)* from Mount Tambourine, Q. *a*, tuberculate area. *b*, normally pitted area. (x 100).

area of the tegmen as in *Chiliocycla*. In Text-fig. 3, I have shown portions of the tegmen of *Philagra* sp., contrasting a tuberculate area (*a*) with a normally pitted area (*b*). In *a*, each tubercle carries a short hair set in a definite socket, alongside of which there is a minute circular area devoid of pigment, probably representing a small gland containing fluid and opening at the base of the hair. I would suggest that the tubercles of *Chiliocycla* only differ from those of *Philagra* in their greater abundance and regularity of arrangement, and in being all of about the same size, those of *Philagra* being unevenly distributed and varying considerably in diameter. No systematic value can be placed upon the presence of these tubercles as regards the family relationships of *Chiliocycla*, as they appear to crop up almost anywhere within the Hemiptera.

Type, Specimen No. 158*a*. (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.



Text-fig.4. *Scytinoptera kokeni* Handl. From Handlirsch. (x 8). For lettering see p.895.

Text-fig.5. *Mesoscytina australis*, n.g. et sp. (x 7·5). For lettering see p.895. The missing clavus is shown dotted in.

Genus SCYTINOPTERA Handl. (Text-fig. 4).

In Text-fig. 4, I have shown the venation of *Scytinoptera kokeni* Handl., from the Upper Permian of the Kama River, Russia, for comparison with *Chiliocycla, Mesoscytina* and other Ipswich genera defined in this paper. Points to be noted are the peculiar shape of the costal margin, the manner of branching of R, the absence of any definite branch of M, and the very regular arrangement of the veins ending on the distal border of the tegmen. The tegmen is tough and leathery in appearance, and is finely pitted all over.

The genus is monotypic, the genotype having been originally described by Handlirsch in 1904 (Mem. Acad. Petersburg, xvi., (5), 3, 1904, Pl., figs. 3, 4.). See also Handlirsch (3, p. 392).

Genus MESOSCYTINA, n.g. (Text-figs. 5-6).

Closely related to *Scytinoptera* Handl., from which it differs in the following points:—M branches into two at about the middle of the wing; M_{3+4} again divides into M_3 and M_4 distally; the branches of M are connected by cross-veins, so that two closed cells are formed between them. R remains unbranched until well beyond half-way along the wing, when it gives off an ascending branchlet (R_1), and soon after divides into R_{2+3} and R_{4+5} the latter again dividing into R_4 and R_5. Two cross-veins between R_{4+5} and M_{1+2} and two between M_{3+4} and Cu_{1a}; the latter diverging strongly from Cu_2 at its origin. The basal portion of the costal margin is convex, instead of being slightly concave as in *Scytinoptera*, and there is a short vein close below it, which is probably Sc.

Genotype, *Mesoscytina australis*, n.sp. (Upper Triassic, Ipswich, Q.).

Two species are represented in the collection; they may be distinguished as follows:—

Sc faintly indicated, curved, reaching well beyond the curved basal portion of R. ——————————*M. australis*, n. sp.

Sc strongly marked, straight, only reaching about as far as the curved portion of R. ——————————*M. affinis*, n. sp.

MESOSCYTINA AUSTRALIS, n.sp. (Text-fig. 5).

Total length, 9.4 mm.; *breadth* at apical end of clavus, 3.5 mm. Tegmen complete, except for the absence of the clavus,

which has been restored on typical Scytinopterid lines in Text-fig. 5.

Peculiarities in the venation which are probably only of specific value are the following:—the slight double-curving of Sc; the presence of a cross-vein connecting R_4 with the extreme tip of R_{2+3} above it; and the irregular course of M_{3+4} from its origin to the point at which it forks, with the consequent obliquity of the cross-veins connecting both it and M_4 with Cu_{1a}.

Tegmen evidently of a tough, leathery nature, finely pitted all over; the costal margin strongly formed basally.

Type, Specimen No. 112*a*. (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.

A comparison of this fossil with *Scytinoptera kokeni* Handl. reveals a close similarity in the apical portions; but the four closed cells present in *M. australis*, n.sp. are only represented by a single closed cell, between M and Cu, in *S. kokeni*.

MESOSCYTINA AFFINIS, n.sp. (Text-fig. 6).

Total length of fragment, 6 mm., representing a tegmen of total length about 9 mm. *Greatest breadth*, 3.3 mm.

Tegmen evidently of a tough, leathery nature, strongly pitted all over; all the veins very strongly marked.

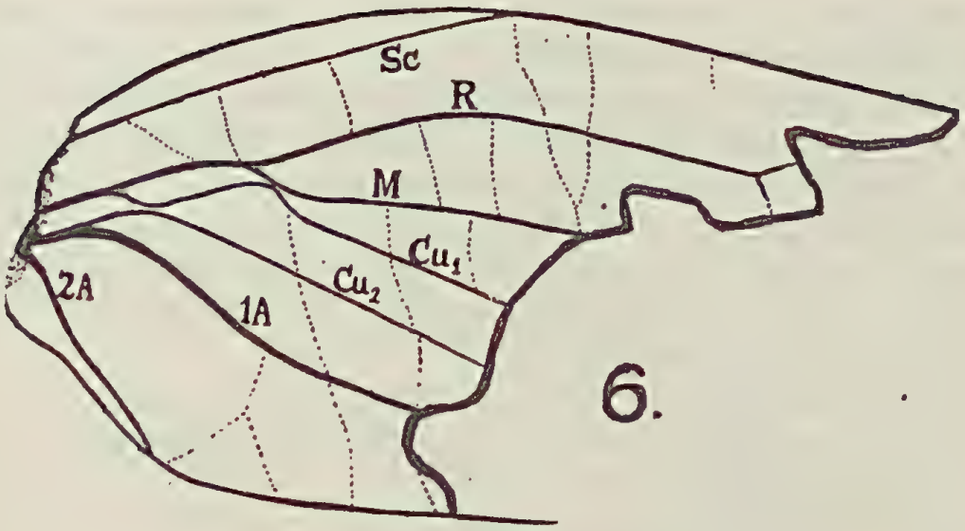
Peculiarities in the venation which are probably only of specific value are the following:—the straight, short course of Sc, and its strongly marked nature; the peculiar curvature of the vein Cu near the base; and the excessive shortness of 2A on the clavus. The dotted lines in Text-fig. 6 indicate definite creases which are probably cracks due to pressure on this tough tegmen during fossilisation.

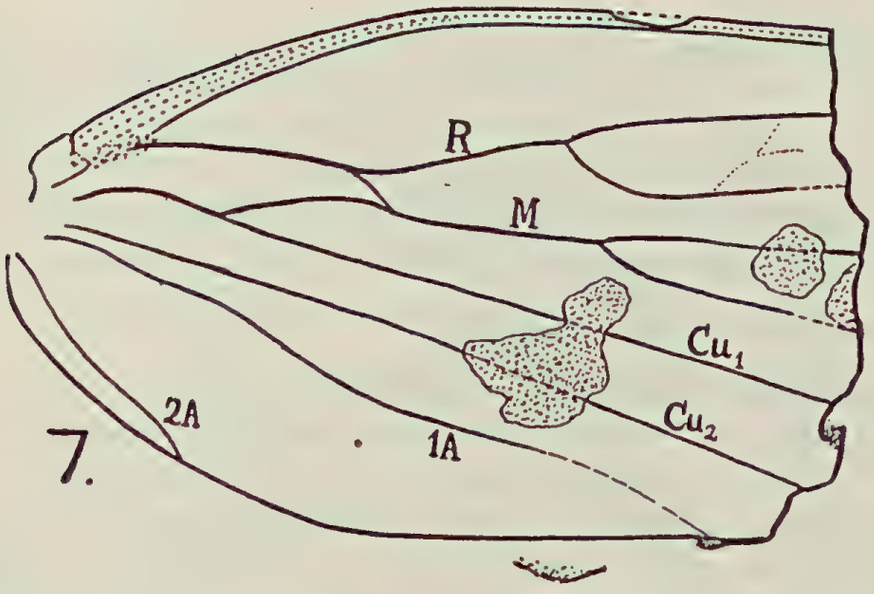
The specimen is very incomplete, being broken off along a very irregular line, as shown in Text-fig. 6. Most of the clavus is preserved, and the vein 1A shows a very definite waviness, 2A being almost straight. The vena dividens, Cu_2, is not very strongly impressed, and there is no difference between the form and size of the pits upon the clavus and the rest of the tegmen.

Type, Specimen No. 235. (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.

The preservation of the clavus in this fossil is of great value, since it enables us to determine at once what was the form and venation of this area in the more typical *Scytinopteridae*.





Text-fig.6. *Mesoscytina affinis*, n.g. et sp. (x 13·5). For lettering see p.895.

Text-fig.7. *Mesodiphthera grandis*, n.g. et sp. (x 6·3). For lettering see p.895.

Genus MESODIPHTHERA, n.g. (Text-fig. 7).

Differs from *Mesoscytina*, n.g. in having R branching dichotomously at a level just before the branching of M. (Basal half of tegmen only preserved).

Genotype, *Mesodiphthera grandis*, n.sp. (Upper Triassic, Ipswich, Q.).

MESODIPHTHERA GRANDIS, n.sp. (Text-fig. 7).

Total length of fragment, 12 mm., representing a tegmen of total length over 20 mm. *Greatest breadth*, 7.5 mm.

The whole of the basal half or more of the tegmen is excellently preserved, including the whole of the clavus except the extreme apex. The peculiarities of the branchings of R and M are well shown in Text-fig. 7. As far as preserved, Cu_1 is a very straight vein, diverging slightly from Cu_2. The peculiar waviness of 1A is very evident; and this vein, as in *Mesoscytina,* stands very far apart from 2A, which is a short vein, very slightly waved. The anal angle of the clavus is broadly rounded, much as in *Mesoscytina.*

The tegmen appears to be of a leathery nature, but not so tough as those of the genus *Mesoscytina;* the indications of pitting are also fainter.

Type, Specimen No. 213 *a-b.* (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.

Text-fig. 7 represents the larger piece of the preserved fossil, which is the *mould,* since the vena dividens stands on a high ridge. Alongside it, in the same box, there is a broken piece of the cast, not so perfect; a study of this does not yield any additional information about the venation of this fossil.

Genus Triassoscarta, n.g. (Text-fig. 8).

R unbranched, but connected with the costal margin by a long series of transverse veinlets, extending from near base to near apex. M and Cu arising together by a very short stalk. On the clavus, vein 2A ends up about as far from the end of 1A as the latter is from the apex of the clavus. (Course of M, beyond half-way, obliterated).

Genotype, *Triassoscarta subcostalis,* n.sp. (Upper Triassic, Ipswich, Q.)

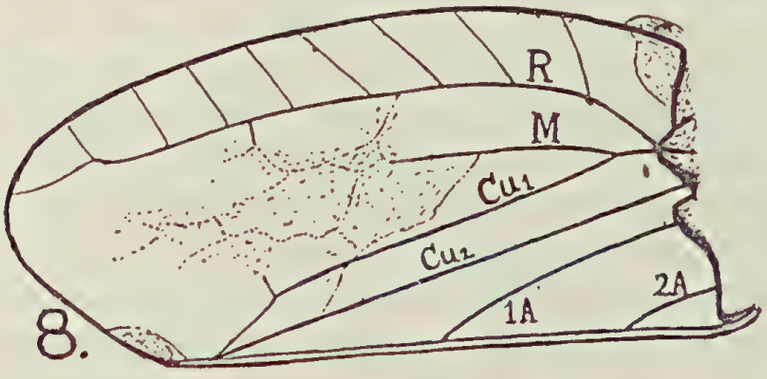
Clearly allied to *Permoscarta,* from the Upper Permian of Newcastle, N.S.W., but differing from it in the simpler structure of R, as explained in the key to the genera.

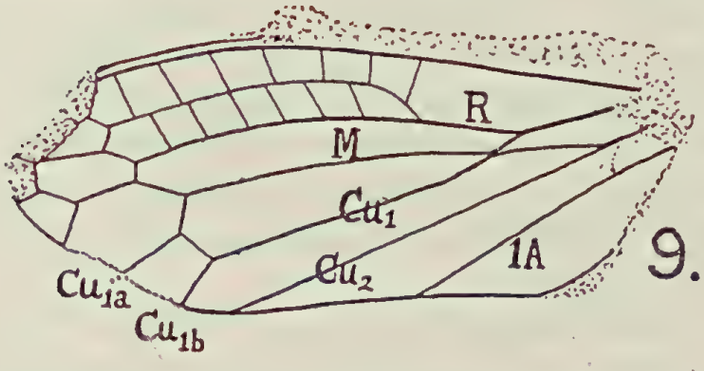
Triassoscarta subcostalis, n.sp. (Text-fig. 8).

Total length, 8 mm. *Greatest breadth,* 3.8 mm.

The number of veinlets connecting R with the costal margin is eight, arranged at approximately equal intervals; the second, third and fourth of these are more obliquely placed than the others. The middle distal portion of the tegmen has the venation obliterated; but there are slight indications that M was

forked near half-way, and the short basal piece of Cu_{1a} visible above the secondary cubital fork suggests that the venation of this part of the tegmen may have resembled somewhat that of *Mesoscytina*. Cu_{1b} is a short, straight vein which descends to meet the vena dividens at the apex of the clavus. 1A and 2A are both well marked, curved veins. The anal angle is well rounded.





Text-fig.8. *Triassoscarta subcostalis*, n.g et sp. (x 7·5). For lettering see p.895.

Text-fig.9. *Permoscarta mitchelli* Till. (x 8·3). For lettering see p.895.

The tegmen appears to be of a leathery nature, finely and closely pitted all over.

Type, Specimen No. 116*a*. (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.

Genus PERMOSCARTA Till.

We figure the tegmen of *Permoscarta mitchelli* Till. in Text-fig. 9, for comparison with that of *Triassoscarta subcostalis*, n.sp. The genus comes from the Upper Permian of Newcastle, N.S.W. (9, p. 726). The chief differences between the two types are given in the generic key above. We may note, in addition, that the radius of *Triassoscarta* arches strongly upwards near the

base, much as the upper branch of R does, further on, in *Permoscarta;* that, in this latter genus, Cu_{1a} does not end at the apical angle of the clavus; and that vein 2A seems to be absent.

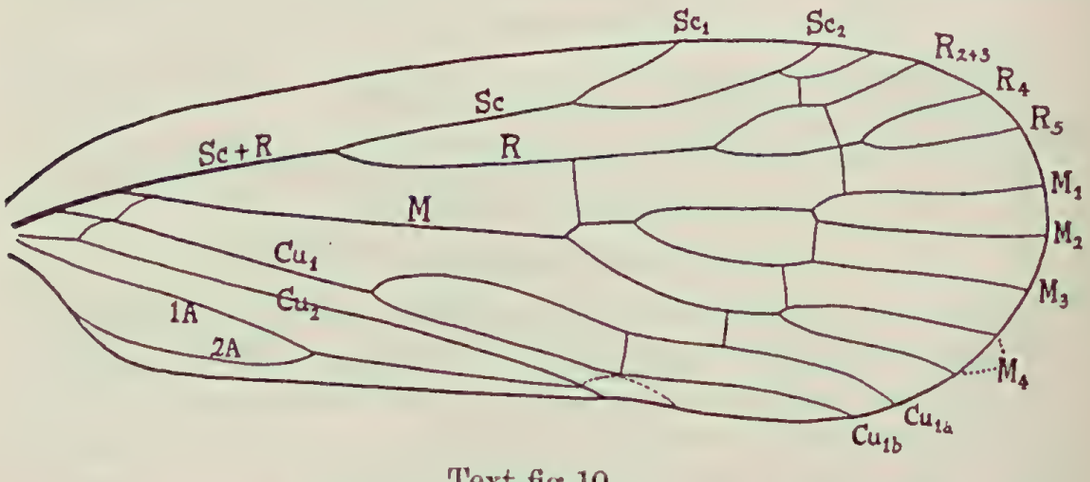
Subfamily MESOCIXIINAE.

Genus MESOCIXIUS, n.g. (Text-fig. 11).

Tegmen considerably broader near base than towards apex. Costal area fairly wide. R branches dichotomously at about one-third of the wing length from the base. The upper branch of R branches again at a point further from the original forking than the latter is from the origin of R; the upper branch so formed sends only two veinlets to the costal border, while the lower divides into two simple branches, R_2 and R_3. M forks dichotomously at about two thirds of the wing length from the base; the upper branch, M_{1+2} divides into two near the border; the lower, M_{3+4}, has four short, subparallel, descending branches. A closed median cell is present, by a strong cross-vein. Cu1 has a strong distal fork. Cu_{1b} ends up a little beyond the apical angle of the clavus, while Cu_{1a} is itself forked near the wing border. Cross-veins connect R_1 with R_2, R_{4+5} with M_{1+2} and M with Cu_{1a}. (Clavus not preserved).

Genotype, *Mesocixius triassicus,* n.sp. (Upper Triassic, Ipswich, Q.).

It is, of course, impossible to decide whether Sc is really present in this fossil or not. The naming of the branches of R is given only provisionally, to facilitate comparison with other genera of the family. If this genus and the succeeding one



Text-fig.10.

Nesocharis sp., tegmen (*Cixiidae*). (x 12). For lettering see p.895.

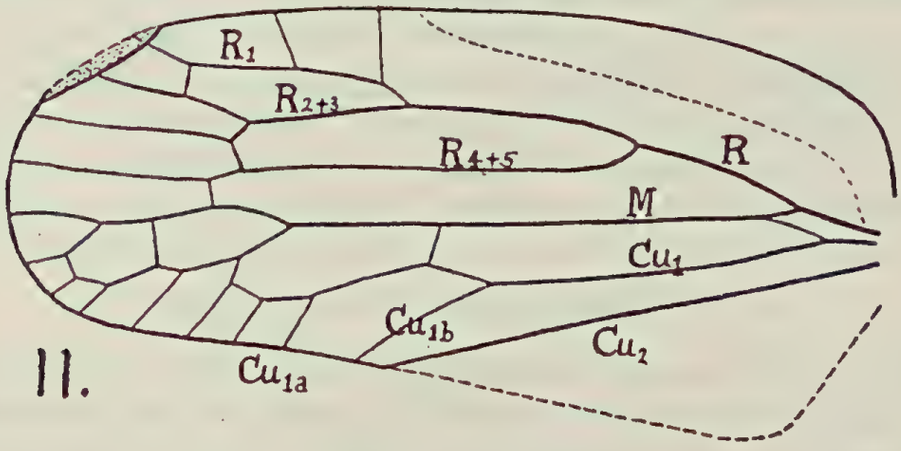
really belong to a group ancestral to the true *Cixiidae,* then it should be noted that the first dichotomy of the vein here called R is really a dichotomy of a fused stem R-Sc into Sc above and R below, and that Sc branches again, while R remains unbranched. For comparison of the venations of the fossil with the true *Cixiidae,* I give, in Text-fig. 10 the venation of the tegmen of *Nesocharis* sp.

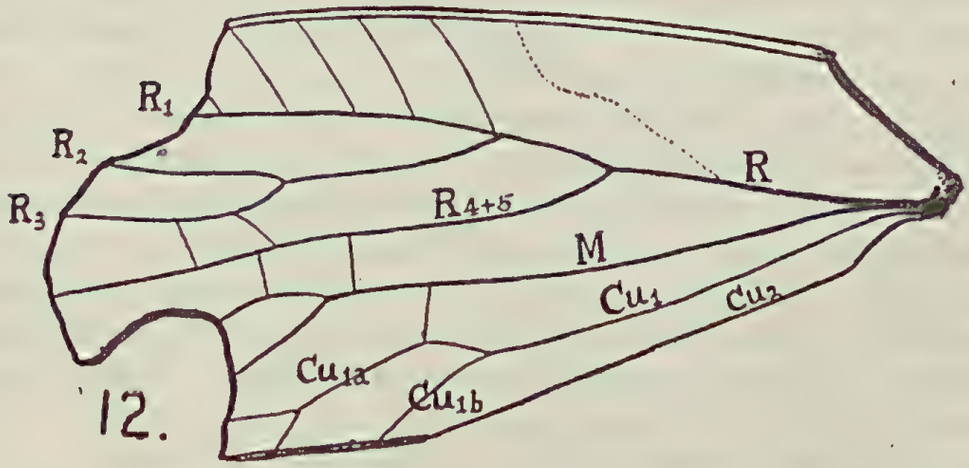
MESOCIXIUS TRIASSICUS, n.sp. (Text-fig. 11).

Total length of tegmen, 10 mm. *Greatest breadth,* 4 mm.

The venational characters have been included in the generic definition. The tegmen appears to have been moderately tough and leathery, and is finely and closely pitted all over. The specimen is complete, except only for a tiny piece missing above the apex, and the loss of the clavus, which, as usual, has become detached along the groove of the vena dividens.

T y p e, Specimen No. 215 (Coll. Queensland Geol. Survey).





Text-fig.11. *Mesocixius triassicus*, n.g. et sp. (x 7·5). For lettering see p.895.

Text-fig.12. *Triassocixius australicus*, n.g. et sp. (x 7·5). For lettering see p.895.

Genus TRIASSOCIXIUS, n.g. (Text-fig. 12).

Allied to *Mesocixius*, from which it differs by the closer approximation of the first and second dichotomies of R, and by the presence of a series of oblique veinlets running from the most anterior branch of R to the costal border. The condition of the media and cubitus is much the same as in *Mesocixius*, but there are two cross-veins between R_{4+5} and M, and also between R_3 and R_{4+5}. (Clavus not preserved.)

Genotype, *Triassocixius australicus*, n.sp. (Upper Triassic, Ipswich, Q.).

With regard to the naming of the branches of R, the same remarks apply to this genus as to the previous one.

TRIASSOCIXIUS AUSTRALICUS, n.sp. (Text-fig. 12).

Greatest length of fragment, 10.5 mm., representing a tegmen of total length about 12.5 mm. *Greatest breadth*, 5 mm.

The venational characters are included in the generic definition. The specimen is incomplete, not only in the loss of the clavus, but also in having a considerable part of the apical area of the tegmen broken off along a very irregular line, together with a small portion of the base. It is very finely and closely pitted all over, closely resembling *Protocixius* in this respect.

Type, Specimen 267*a*. (Coll. Queensland Geol. Survey).

Family IPSVICIIDAE.

On the clavus, veins 1A and 2A form a definite Y-vein, but 2A lies very close to the margin for portion of its length. Tegmina of moderate size and of a peculiar cultriform shape, the apex more or less pointed, the anal angle strongly marked, and the posterior border from this angle to near the apex quite straight. Main veins separate at their bases, but Sc, R, M and Cu all meet at a point not far from the base, much as in the more typical *Scytinopteridae*. From this point only two veins proceed distad, the anterior one being R, the posterior one M + Cu, which divides further distad into M and Cu. The distal portions of these veins very indistinctly marked. Border of tegmen thickened, especially anteriorly, into a coriaceous margin.

Genus IPSVICIA, n.g. (Text-figs. 13-15).

R gives off a series of transverse branches to the anterior border. Cu diverges from M at about one-third of the wing-

length from the base, or less. The whole tegmen is covered with irregularly placed patches of small tubercles, very definitely preserved in the fossils, and apparently originally pigmented; these give a very definite pattern to the tegmen, and are of quite a unique appearance. Between these patches, the tegmen is finely pitted all over, the pits being shallow and placed farther apart than are the tubercles in the patches, and evenly aligned along the courses of the main veins.

Genotype, *Ipsvicia jonesi*, n.sp. (Upper Triassic, Ipswich, Q.).

Three species of *Ipsvicia* are represented in the Ipswich Beds. They may be separated by the following key:—

(1) Apex of tegmen sharply pointed. ——— *I. acutipennis*, n. sp.
(1) Apex of tegmen broader and more rounded. ——— 2.

(2) M and Cu united for a distance distinctly less than the width of the space between R and the costal border above it. Tubercular patches distinct and well separated. ——— *I. maculata*, n. sp.
(2) M and Cu united for a distance slightly greater than the width of the space between R and the costal border above it. Tubercular patches larger, some of them more or less confluent. ——— *I. jonesi*, n. sp.

Ipsvicia jonesi, n.sp. (Text-fig. 13).

A complete and beautifully preserved tegmen, representing the *mould* of a left tegmen, and therefore having its apex to the right (1A stands on a high ridge in the fossil, whereas in the actual wing it lies in a deep furrow).

Total length, 14.2 mm. *Greatest breadth*, 5.6 mm.

Veins of the clavus distinct, those of the rest of the tegmen faint, becoming very indistinct distally, so that their terminal branchlets cannot be made out with certainty. (This is not due to faulty preservation, but is the actual condition of the venation in the insect, as in the case of *Philagra* and other Fulgoroids, in which the membrane of the tegmen has become much thickened). Sc, R, M and Cu are well-marked from the base to their point of union, from which a transverse vein runs upwards, very distinctly, to the costal border. Costal border coriaceous, wide and strongly built. Between it and R there are altogether nine weakly-indicated cross-branches, besides the one already

length from the base, or less. The whole tegmen is covered with irregularly placed patches of small tubercles, very definitely preserved in the fossils, and apparently originally pigmented; these give a very definite pattern to the tegmen, and are of quite a unique appearance. Between these patches, the tegmen is finely pitted all over, the pits being shallow and placed farther apart than are the tubercles in the patches, and evenly aligned along the courses of the main veins.

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(1) Apex of tegmen broader and more rounded. ——— 2.

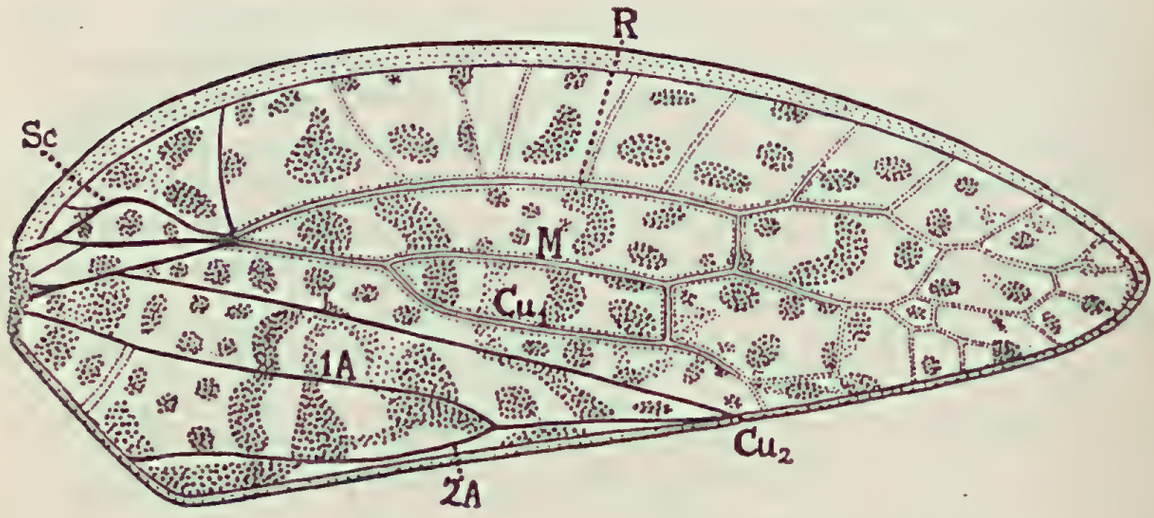
(2) M and Cu united for a distance distinctly less than the width of the space between R and the costal border above it. Tubercular patches distinct and well separated. ——— *I. maculata*, n. sp.
(2) M and Cu united for a distance slightly greater than the width of the space between R and the costal border above it. Tubercular patches larger, some of them more or less confluent. ——— *I. jonesi*, n. sp.

IPSVICIA JONESI, n.sp. (Text-fig. 13).

A complete and beautifully preserved tegmen, representing the *mould* of a left tegmen, and therefore having its apex to the right (1A stands on a high ridge in the fossil, whereas in the actual wing it lies in a deep furrow).

Total length, 14.2 mm. *Greatest breadth*, 5.6 mm.

Veins of the clavus distinct, those of the rest of the tegmen faint, becoming very indistinct distally, so that their terminal branchlets cannot be made out with certainty. (This is not due to faulty preservation, but is the actual condition of the venation in the insect, as in the case of *Philagra* and other Fulgoroids, in which the membrane of the tegmen has become much thickened). Sc, R, M and Cu are well-marked from the base to their point of union, from which a transverse vein runs upwards, very distinctly, to the costal border. Costal border coriaceous, wide and strongly built. Between it and R there are altogether nine weakly-indicated cross-branches, besides the one already



Text-fig.13.
Ipsvicia jonesi, n.g. et sp. (x 6·7). For lettering see p.895.

mentioned. Of these, the first is inclined upwards and inwards obliquely, the second is very faint and also slightly inclined upwards and inwards, the third arises on R very close to the second, but inclines upwards and outwards, the rest are placed at fairly equal intervals, inclined upwards and outwards, the ninth being a small twig near the end of R. R is united with M, at about one-third of the wing-length from the base, by a strong cross-vein, and, beyond this, by two more very indistinct and somewhat oblique cross-veins, which thus separate out, between R and M, two distinct, irregular polygonal areas. Below these, M branches into weak and irregular twigs, very difficult to follow. M is connected with Cu by a well-marked cross-vein at a level somewhat basad from the strong cross-vein connecting R with M. Beyond this, Cu becomes very faint, but appears to arch downwards so as to end up close to the apex of the clavus, and gives off also a faint distal branch, which is connected again with M by a faint cross-vein. In the clavus, the Y-vein is very distinct, but 3A must be followed out with care, as it runs very close to the border, and might be mistaken for it under a cursory survey.

The pattern of the tubercular patches is well shown in Text-fig. 13. The smaller patches are round or oval, the larger ones often reniform, and some of them are connected by areas in which tuberculation is evident, but not so strongly developed. The preservation of the separate, minute, flattened tubercles forming these patches is perfect.

This tegmen appears almost unicolorous in the fossil; but it is probable that the tubercular areas would have appeared pigmented in the cast, if that had been preserved, seeing that, in the other two species, in which portions of both cast and mould are preserved, the former shows the patches strongly darkened.

Type, Specimen No. 122*a*. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

This tegmen is certainly the most perfect of all the Ipswich fossils, and it would be hard to imagine that any wing could be preserved in better condition.

It gives me much pleasure to dedicate this species to Mr. A. J. Jones, the present Minister for Mines in Queensland.

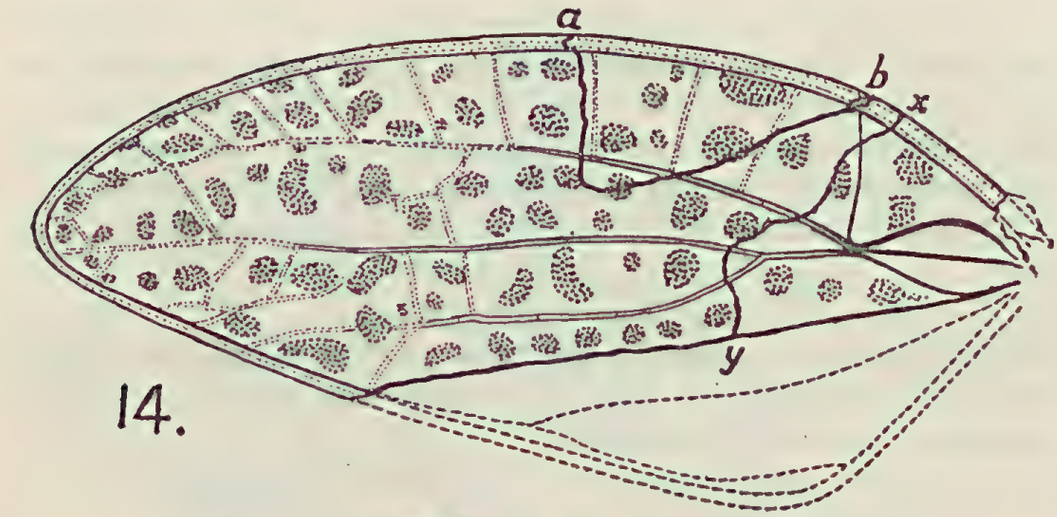
IPSVICIA MACULATA, n.sp. (Text-fig. 14).

This species is represented by portions of both cast and mould of a right tegmen. Of these, the cast shows the whole tegmen, except only the clavus, which is broken off irregularly along 1A, and the base of the tegmen above it, which is missing as far as the line *xy* in Text-fig. 14. The mould also has the clavus missing, but the base of the wing is preserved; there is, however, a piece missing from the costal border, out of which a triangular piece has been torn, as represented by the line *ab* in the same figure. Making separate drawings of both cast and mould, reversing one and placing it on top of the other, we get the composite figure shown in Text-fig. 14, which has been drawn with apex to the left, for convenience of arrangement with the figures of the other two species.

Total length, 13.5 mm. *Greatest breadth,* 4.6 mm. at apex of clavus, representing a probable maximum breadth at the claval angle of about 5.8 mm.

This species comes close to *I. jonesi,* n.sp., from which it may be distinguished as follows:—

The coriaceous costal border is not so strongly built. The width across the tegmen at the apex of the clavus is greater, though the total length of the tegmen is slightly less; this indicates a somewhat different shape, as shown in the restored tegmen in Text-fig. 14. Veins very faintly indicated. R tends to converge towards the costal border distally, so that the space between them narrows gradually, instead of remaining nearly the same length throughout, as in *I. jonesi.* There are ten cross-



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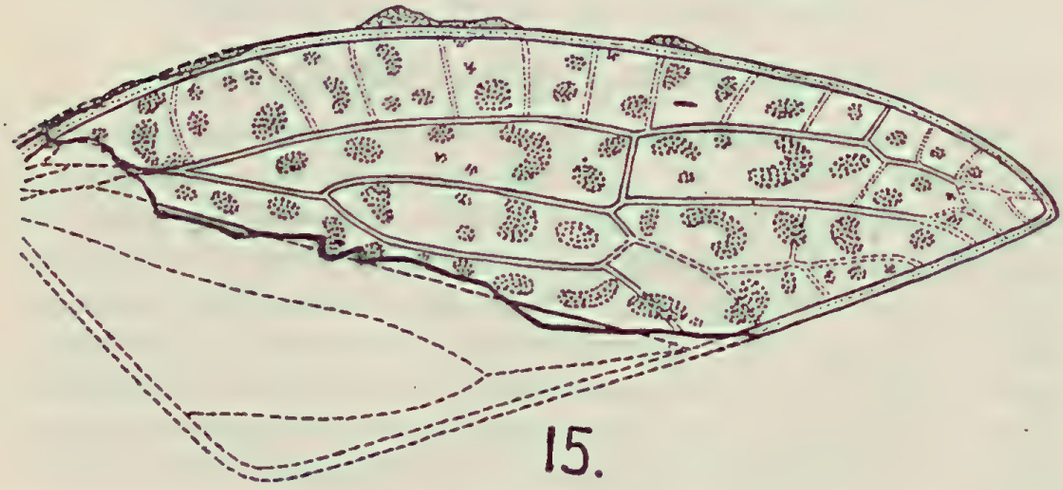


15.

Text-fig.14. *Ipsvicia maculata*, n.g. et sp. (x 6·7). The missing clavus is shown dotted in, restored on the plan of *I. jonesi*. For lettering see p.895.

Text-fig.15. *Ipsvicia acutipennis*, n.g. et sp. (x 6·7). The missing clavus is shown dotted in, restored on the plan of *I. jonesi*. For lettering see p.895.

veins in this space, including the one from the point of union of the main veins; these are more regularly spaced than in *I. jonesi,* the second and third being at a normal distance apart. Instead of R and M being united by a straight cross-vein, at a distance of one-third the wing-length from the apex, as in *I. jonesi,* R appears to give off a weak posterior branch somewhat beyond half-way along the wing, and the cross-vein to M descends from this branch, whose further course is obliterated.

M and Cu are united for a much shorter length than in *I. jonesi;* their distal courses are too faint to be made out with certainty. The tubercular patches are smaller, more distinct and more separated than in *I. jonesi,* and appear of a dark brown colour on a pale ground. Between these patches, the tegmen is strongly pitted all over, the pits being fairly large and shallow, and placed considerably further apart than are the tubercles of the patches. The courses of the veins are marked by the regular arrangement of these pits along either side of them.

Type, Specimens 208*a* (cast) and 208*b* (mould), in separate boxes. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

The specific name indicates the very strongly spotted appearance of the tegmen, especially in the cast, when viewed with the naked eye.

IPSVICIA ACUTIPENNIS, n.sp. (Text-fig. 15).

This species is represented by a well preserved cast, broken off irregularly along the vein 1A, so that the whole of the clavus and a small portion of the base are missing; also by a small portion of the mould, showing only the middle parts of the veins R, M and Cu.

Total length, 13.5 mm. *Greatest breadth,* 4 mm., just beyond apex of clavus.

Apex much more acute than in the two preceding species, the costal coriaceous border less strongly marked, the space between costal margin and R distinctly narrower, and crossed by twelve regularly arranged cross-veins. R is united with M by a strong cross-vein as in *I. jonesi,* but the course of M beyond this point is much straighter than in that species. M united with Cu for about the same distance as in *I. jonesi;* just before the level of the cross-vein connecting it with R, M gives off a descending branch, which meets the upper branch of Cu, thus forming an elongate closed area between them. Distal courses of Cu and lower branch of M indistinct, but rest of venation more clearly marked than in the other two species.

Tubercular patches small, distinct and separate, much as in *I. maculata,* the previous species, and appearing strongly pigmented in dark brown, on a pale ground-colour, especially in the cast.

Type, Specimens 204*a* (cast) and 204*b* (mould), glued side by side in a single box. (Coll. Queensland Geological Survey).
Horizon: Upper Triassic, Ipswich, Q.

Family JASSIDAE.

Sc usually absent; if present, weakly formed, and not looped up with R as in *Cercopidae*. R, M and usually Cu_1 fused together into a single stalk basally for an appreciable distance. Clavus triangular, the anal angle obtuse; separated from the rest of the tegmen by a straight vena dividens (Cu_2'). No claval Y-vein; the claval veins 1A and 2A both usually present, placed far apart. 1A usually waved, 2A enclosing the anal angle.

Key to the Upper Triassic Genera.

(1)
- Cu_{1b} ending up exactly at apex of clavus; apical third of tegmen with many closed cells. ——— *Eurymelidium*, n.g.
- Cu_{1b} ending up somewhat beyond apex of clavus; apical third of tegmen with few closed cells. ——— 2.

(2)
- R without apparent longitudinal branches; the median cell *(mc)* normal, without any supporting cells beneath it. ——— *Mesojassus* Till.
- R with definite longitudinal branches; the median cell *(mc)* abnormal, divided by a cross-vein, and with small supporting cells between it and the cubitus. ——— *Triassojassus*, n.g.

Genus EURYMELIDIUM, n.g. (Text-fig. 16).

Sc absent. R, M and Cu_1 fused together for a considerable distance from base. Distance between origin of Cu_1 from common stem and point of separation of R from M less than length of common stem of all three veins. After leaving M, R arches up considerably towards costa, then bends away again, dividing into R_{2+3} and R_{4+5}, the latter fusing almost at once with M_{1+2}. Between R_{2+3} and costal margin is a series of transverse veinlets, of which the first may represent the shortened R_1. Courses of R_{2+3} and R_{4+5} somewhat irregular, the space between them divided by three cross-veins into cells. After leaving R, M bends downwards; about the middle of the wing, it divides into M_{1+2} and M_{3+4}, the former arching up to unite with R_{4+5}, the latter continuing straight on; the space between the two branches of M is divided up by four cross-veins into cells. Two cross-veins connect M with Cu, one being not far from the origin of M

from the common stalk, the other much further distad. Cu_{1a} fused with M_{3+4} for a short distance, so that its basal portion resembles a cross-vein. Cu_{1b} ending up exactly upon the apical angle of the clavus. On the clavus, 1A is waved and diverging strongly from the vena dividens.

Genotype, *Eurymelidium australe*, n.sp. (Upper Triassic, Ipswich, Q.)

EURYMELIDIUM AUSTRALE, n.sp. (Text-fig. 16).

Total length of preserved portion of tegmen, 5 mm., representing a complete tegmen of about 5.5 mm. long. *Greatest breadth*, 2 mm.

The tegmen is closely pitted all over, the venation being fairly strongly marked. There is a slight piece out of the costal margin near the middle, and a small part of the base is missing; otherwise, the preservation is complete. The venational characters have been included in the generic definition.

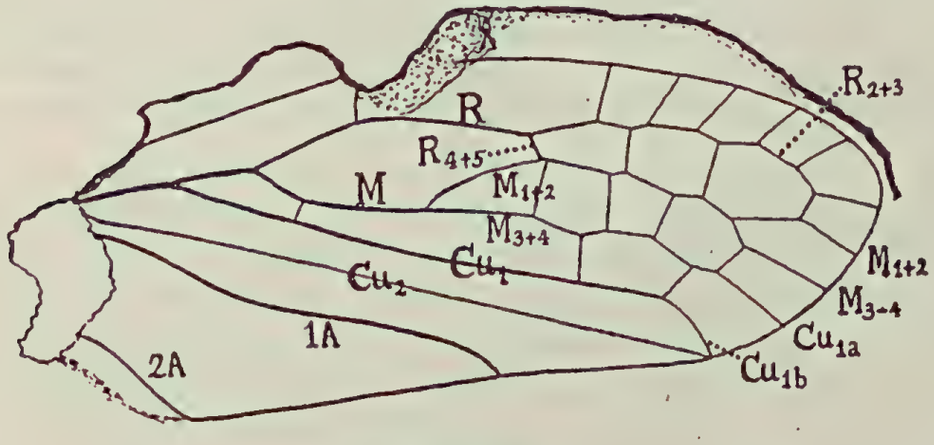
Type, Specimen No. 248*a*. (Coll. Queensland Geol. Survey).

A comparison with Text-fig. 1*c* will show the resemblance of this fossil to the existing Australian genus *Eurymela*.

Genus MESOJASSUS Till. (Text-fig. 17).

Mesojassus Tillyard, 1916 (8, p. 34).

Sc slightly indicated as a separate vein running a little below the costal margin. R, M and Cu_1 united in a common stalk for a considerable distance from base, Cu_1 coming off from it very strongly, M as a weakly indicated vein at a considerably further distance along it. R with no longitudinal branchings, but giving



Text-fig. 16.

Eurymelidium australe, n.g.et.sp. (x 13·3). For lettering see p. 895.

off a strong transverse veinlet (probably R^1) before half-way, then running straight and without any branches for some distance, and finally becoming slightly zig-zagged distally, giving off two more veinlets to the costal margin, and connected with M_{1+2} by two cross-veins. Main stem of M very weakly chitinised; it divides into two about the middle of the wing, and remains weak for the basal half of the length of the median cell (*mc*) after which it becomes more strongly marked. Median cell (*mc*) of normal form, closed distally by a cross-vein, and connected below by another cross-vein with Cu_{1a}. Distal fork of Cu_1 very small; Cu_{1b} ending up at an appreciable distance from the end of the vena dividens. On the clavus, 1A is waved, but diverges very little from Cu_2; 2A encloses the anal angle.

Genotype, *Mesojassus ipsviciensis* Till. (Upper Triassic of Ipswich, Q.)

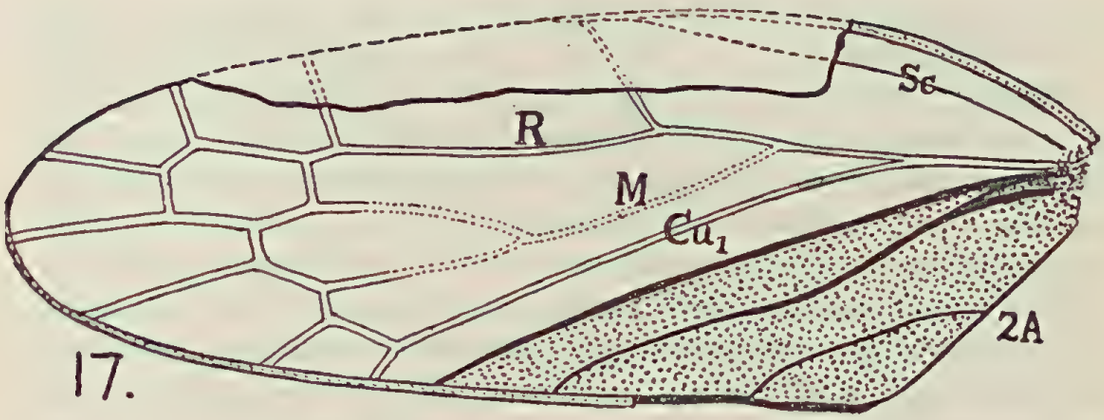
My original definition of this genus (8, p. 34) was very incomplete, as I had not then succeeded in obtaining a really good drawing of the fossil, in which the impression of the venation is weak, especially in the region of M. The drawing given in Text-fig. 17 was made under exceptionally good conditions in very strong, oblique, evening sunlight, and adds much to our knowledge of this interesting fossil form. In the original generic definition, the condition of the pitting of the wing was included. I do not now regard this as of more than specific value. The genus itself is not far removed from the recent genus *Jassus*.

MESOJASSUS IPSVICIENSIS Till. (Text-fig. 17).

Mesojassus ipsviciensis Till., 1916, (8, p. 35, Plate 2, fig. 7).

Total length, 6.2 mm.; *greatest breadth*, 2.2 mm. (The measurements given in my original description were somewhat smaller, owing to the limits of the tegmen not being clearly made out).

The pitting of the tegmen is not quite as described by me originally. The basal portion of the tegmen is fairly strongly pitted, but the pits become more and more indistinct towards the distal end. Transversely across the middle of the wing there is an indication of a change in the amount of pigmentation, the basal half being somewhat darker than the distal; but I do not think that this line indicates the limit of any special development of the pitting.



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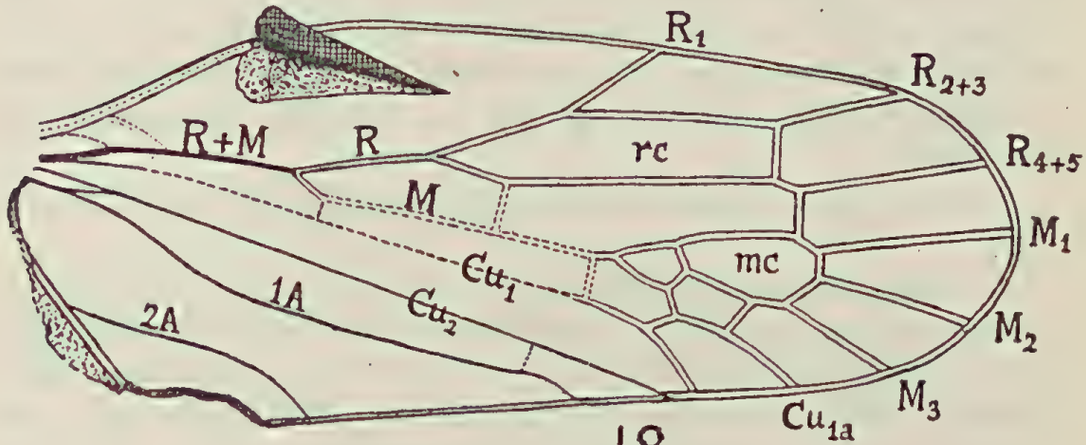


18.

Text.fig.17. *Mesojassus ipsviciensis*, Till. (x 15). For lettering see p.895.

Text-fig.18. *Triassojassus proavitus*, n.g. et sp. (x 15). For lettering see p.895.

Apart from the fact that there is a considerable portion of the costal area missing, this tegmen is perfect.

Type, Specimen No. 33. (Coll. Queensland Geol. Survey).

Genus TRIASSOJASSUS, n.g. (Text-fig. 18).

Costal margin strongly arched from near the base outwards in the basal third of the tegmen. Sc absent. Cu_1 departing from R + M very close to the base. R and M fused together for more than one-fourth of the wing-length. R divides, a little before half-way along the wing, into R_{1-3} and R_{4+5}. The former gives off R_1 as a very distinct oblique veinlet to the costal margin, a little beyond half-way along the wing. R_{2+3} and R_{4+5} run subparallel to one another and unbranched to the

apical margin, and are connected by a single cross-vein, which closes the radial cell (*rc*) distally. Basal portion of M weakly chitinised, and connected with R_{4+5}, not far from its origin, by a weak cross-vein. M forks well beyond half-way along the wing, sending finally three distinct branches to the distal margin of the wing. Cross-veins between these and connecting them with Cu_1 are so arranged that a set of four irregular cells are formed, two between the branches of M, and therefore representing the true median cell (*mc*), and two below these, between M and Cu_1. Cu_1 weakly chitinised, its fork normal; a short, weak cross-vein connected Cu_1 with M just distad from the origin of the latter; Cu_{1b} ends up slightly distad from the apex of the clavus. On the clavus, 1A is waved, but approaches the vena dividens distally, and ends up not far from it; 2A encloses the anal angle.

Genotype, *Triassojassus proavitus*, n.sp. (Upper Triassic, Ipswich, Q.).

A comparison between this genus and *Eurymela* (Text-fig. 1*c*) shows the very primitive condition of the radius in the fossil type, R_1 being distinct, and R_{4+5} remaining a complete longitudinal vein, without any fusion with M. This condition is also to be found in the Liassic genus *Archijassus* Handl. (3, p. 501), which also agrees with *Triassojassus* in having the median cell divided by a cross-vein. *Archijassus*, however, has two cross-veins connecting R_{2+3} with R_{4+5}, and three connecting the latter with M_{1+2}; also, it has four distinct distal branches to M, and, apparently, from Handlirsch's figure (3, Atlas, Plate xliii., fig. 41, copied from Geinitz) it had not less than three distinct anal veins upon the clavus, like the Permian genus *Permofulgor*. Handlirsch figures three other species placed provisionally in *Archijassus*, but they are not well preserved, and need not be discussed here.

TRIASSOJASSUS PROAVITUS, n.sp. (Text-fig. 18).

Total length, 5.8 mm. *Greatest breadth*, 2.2 mm.

The tegmen is beautifully preserved, and complete except for a small piece missing at the anal angle of the clavus, and the mark of the knife or chisel used in delamination of the rock, which has cut into the costal area as shown in Text-fig. 18. The impression is of a dark colour, finely pitted on the clavus, but elsewhere almost smooth. As the vena dividens stands upon a

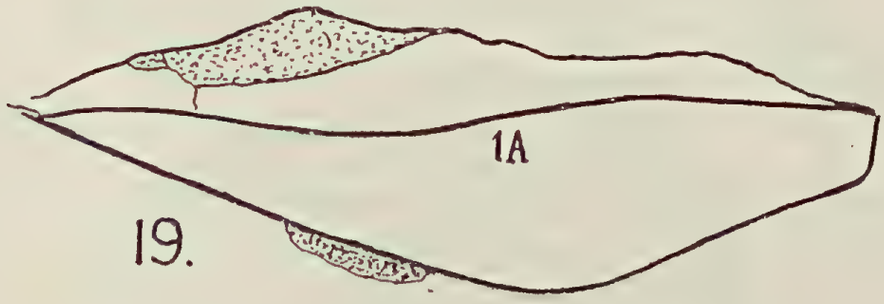
high ridge, the impression is actually a *mould* of a left tegmen, and the pits of the clavus appear as slightly raised tubercles.

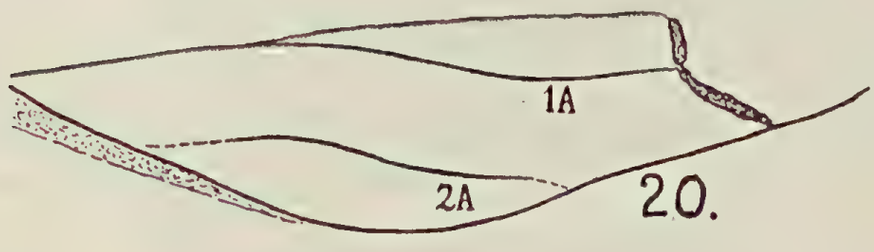
Type, Specimen 191*a*. (Coll. Queensland Geol. Survey).

Unnamed Claval Areas.

Amongst the fossil Homoptera dealt with in this paper, there are five portions of tegmina consisting chiefly or entirely of the claval area, which are worth figuring, though they cannot be named. These are Specimens No. 109*a*, 163, 172*a*, 247*a-b* and 257*b*.

Specimen No. 109a is shown in Text-fig. 19. It is portion of the clavus of a very large tegmen, the fragment measuring



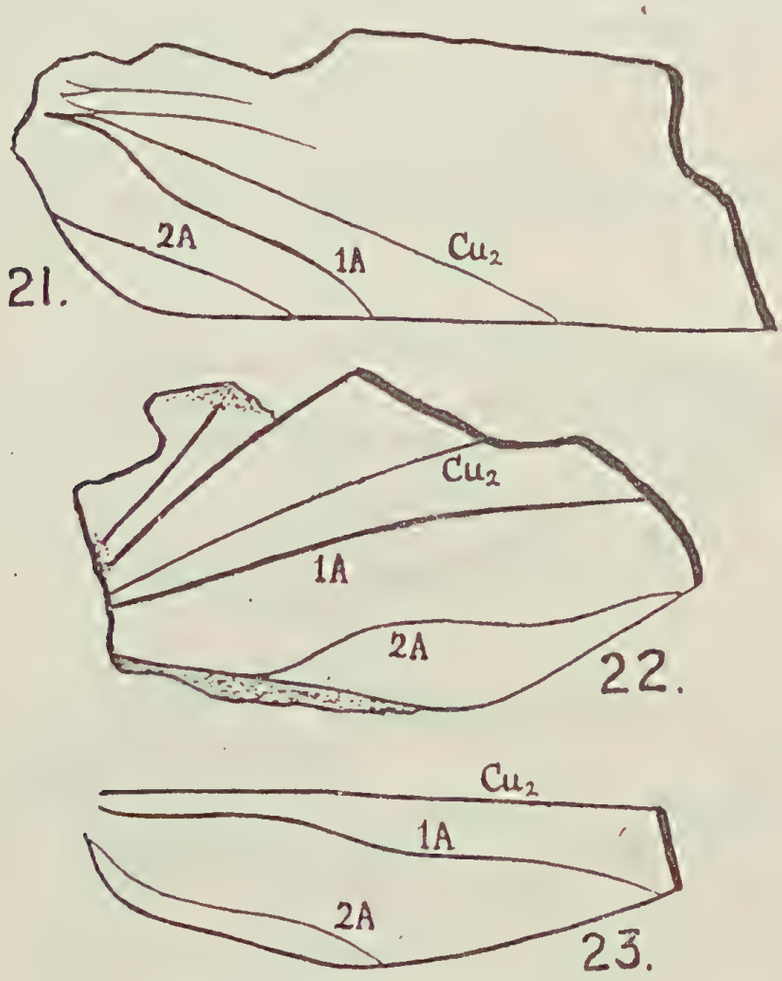


Text-fig. 19. Specimen No. 109*a*. (x 6·7).

Text-fig. 20. Specimen No. 163. (x 6.7).

10.5 mm. in length, so that the complete clavus must have been at least 12 mm., and the tegmen probably 15 mm. or more in length. The specimen is a mould, showing only the vein 1A strongly impressed upon a tough, leathery clavus with shallow, irregular pitting and considerable pigmentation in the form of large, dark patches of irregular shape. 2A is absent; hence it is possible that it belonged to a large Cercopid.

Specimen No. 163 is shown in Text-fig. 20. This is somewhat more complete than the last specimen, and shows most of 1A, together with all of 2A, on a clavus which is unicolorous and finely pitted all over. The specimen is a *cast*. Total length 10 mm. It probably belongs to a large Scytinopterid.



Text-fig.21. Specimen No. 172*a*. (x 7·5).
Text-fig.22. Specimen No. 247*a-b*. (x 7·5).
Text-fig.23. Specimen No. 257. (x 7·5).

Specimen No. 172a is shown in Text-fig. 21. A considerable portion of the tegmen is preserved, but there is no definite venation except upon the clavus. Cu_2, 1A and 2A are all clearly marked, together with the extreme basal portions of the veins

Cu_1 and M. The tegmen is roughly granulate. Total length of fragment, 5 mm., of clavus, 3.6 mm. In this specimen, vein 1A is waved, and diverges from Cu_2 much as it does in the genus *Eurymelidium*. But 2A is nearly straight, and ends up rather close to 1A. The specimen may possibly belong to the *Jassidae*.

Specimen No. 247a-b shows, in the same box, side by side, portions of the cast and mould of the base of a fairly large tegmen, of a dark colour and tough, leathery appearance, and lightly granulate all over. Total length of fragment, nearly 7 mm. About half of the vena dividens (Cu_2) is preserved, with most of 1A and the whole of 2A and the anal angle; there are also short pieces of Cu_1 and M shown above these. 1A is fairly straight, 2A very waved, a condition which suggests some resemblance to Scytinopterid genus *Triassoscarta*. (Text-fig. 22).

Specimen No. 257b is a nearly complete clavus, finely pitted, and about 7 mm. long. 1A is waved, and diverges considerably from Cu_2. 2A is waved, and runs very close alongside the somewhat flattened-in anal border. This clavus should belong to some Scytinopterid genus. (Text-fig. 23).

It is worthy of note that none of the claval areas preserved in the Ipswich Homoptera, with the single exception of the genus *Ipsvicia*, shows any formation of a Y-vein. In the *Ipsviciidae*, the Y-vein is only just formed, 2A being, for part of its length, very close indeed to the border of the clavus. But for this character, the venation of the rest of the tegmen in this family would suggest that they belonged to the *Cercopidae*, though the condition of Sc is probably more specialised than it is in this latter family.

Other Unnamed Specimens.

Besides the above, there are no less than five specimens which I have considered too fragmentary or too poorly preserved to merit either naming or figuring. These are Specimens No. 164*a*, 164*b*, (mould and cast, respectively, of the same tegmen), 176*a*, 184*a*, 192*a-b* and 234. Of these, No. 184*a* appears to be a tegmen of the genus *Triassoscarta*, the basal part of the series of costal veinlets being clearly visible. No. 192*a-b* shows two main veins branching much like R and M in *Mesodiphthera*, and is evidently a small part of a large tegmen. The rest are too poorly preserved to invite comment.

NOTE ON THE PHYLOGENY OF THE HOMOPTERA.

A study of the known Homoptera from Permian and Triassic strata should now convince us that the forms which I have included under the family *Scytinopteridae* represent very closely the original type of tegmen for this Suborder. There was little or no fusion of the veins at the base of the wing, and great diversity of the manner of branching of R, M and Cu. The clavus was marked off from the rest of the wing along a fairly straight *vena dividens* (Cu_2), and its anal angle was more or less rounded, not angulated. Either three, or only two, anal (or claval) veins were present, without any approach to union of 1A with 2A to form a Y-vein. This type, as represented by *Scytinoptera* in the Upper Permian, or by the allied *Mesoscytina* or *Chiliocycla* of the Upper Trias of Ipswich, is not very far removed from the Palæohemipterous genus *Prosbole,* from the Upper Permian, from which I have already pointed out that the Triassic *Dunstaniidae,* and therefore the whole of the Heteroptera, may be derived.

As far as we know at present, the only recent family that appears in the Trias is the *Jassidae.* The *Ipsviciidae* are to be regarded as an early specialisation of a remarkable kind, possibly foreshadowing the later *Cercopidae,* but almost certainly not ancestral to these latter. They may be considered as having died out, leaving no recent representatives. True *Cercopidae* appear first in the Lias, there being no reason, so far as I can see, to doubt that Handlirsch's *Procercopis* belonged to this family. True Fulgoroids also appear for the first time in the Lias (genus *Fulgoridium* Handl.). But this great group, which in many respects represents the highest development of the old Auchenorrhynchous stem, may well have originated amongst the Cixiid-like forms of the subfamily *Mesocixiinae* within the family *Scytinopteridae,* by development of the claval Y-vein from the more primitive Scytinopterid condition.

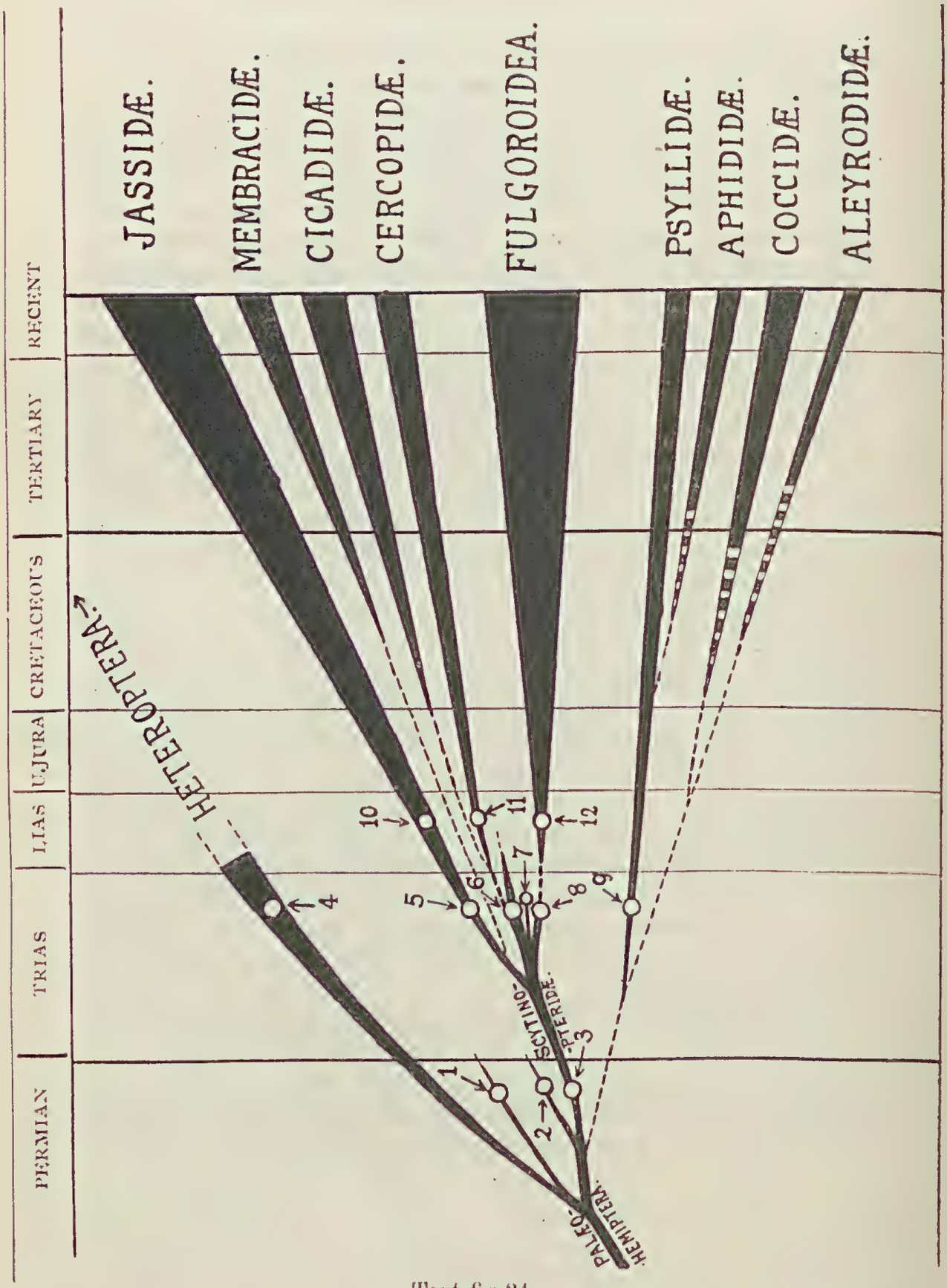
The oldest known Psyllid is *Triassopsylla* from the Upper Trias. This family is also known from the Lias. The *Aphididae, Coccidae* and *Aleyrodidae* are later and more specialised developments from the same stem as the *Psyllidae.*

Structurally the *Cicadidae* are undoubtedly archaic in many of their characters. But they are not found fossil before the Cretaceous, and the origin of the family is at present a mystery. They are undoubtedly closely allied to the *Cercopidae.* Ancestors

with distinct Cicadid characters in their venation might be expected to have existed somewhere in the Trias, but apparently neither in Australia nor in the Northern Hemisphere.

It would appear proved that the Homoptera became differentiated from a single Palæohemipterous stock, of which *Prosbole* is a representative, in the Middle or Upper Permian. From the same stock the Heteroptera became separated off at a somewhat later period, the oldest true Heteroptera known being the *Dunstaniidae* from the Upper Trias of Ipswich. Thus the Homoptera are older than the Heteroptera, as is evident on morphological as well as palæontological grounds. The separation of the Sternorrhyncha from the Auchenorrhyncha must have taken place before the Upper Trias. The oldest existing family of the Auchenorrhyncha appears to be the *Jassidae;* the oldest of the Sternorrhyncha are the *Psyllidae.* Venationally, but not in all other characters, the *Jassidae* are the older of these two. It may also be pointed out that, after the Jassids became differentiated out, the old main stem of the Auchenorrhyncha went on, and continued to be represented by many forms which, *in certain directions,* still preserved archaic characters which the Jassids had lost (e.g., the existence of a well developed subcostal vein). Thus there is no difficulty in understanding how the Fulgoroidea and the *Cercopidae* could have arisen *later in point of time* than the *Jassidae,* though preserving certain archaic features which the Jassids had lost. This is the same problem as that which confronts us in studying the Panorpoid Orders, in which it is clear, palæontologically, that the Mecoptera were the first recent Order to be differentiated out, though they are, in some respects, more highly specialised than other Orders, which arose from the main Panorpoid stem *at later dates,* such as the Megaloptera.

The above ideas may be expressed in the Phylogenetic Diagram given herewith in Text-fig. 24. There can be no doubt that further exploration of the Ipswich Beds would yield us more valuable material in the Homoptera, and help to fill in the gaps that are only too evident in the present state of our knowledge.


PERMIAN
TRIAS
LIAS
JURA
CRETACEOUS
TERTIARY
RECENT
JASSIDÆ.
MEMBRACIDÆ.
CICADIDÆ.
CERCOPIDÆ.
FULGOROIDEA.
PSYLLIDÆ.
APHIDIDÆ.
COCCIDÆ.
ALEYRODIDÆ.
HETEROPTERA.
PALÆO-HEMIPTERA.
SCYTINO-PTERIDÆ.
1
2
3
4
5
6
7
8
9
10
11
12

Text-fig. 24.

Text-fig.24.

Diagram showing the phylogeny of the Homoptera. There is no palaeontological evidence for the portion of the phylogenetic scheme shown by means of broken lines. The positions of important fossil types are indicated by circles, to which numbers are attached by means of arrows, as follows:—*1*, *Prosbole*; *2*, *Permofulgor*; *3*, *Scytinoptera* and *Permoscarta*; *4*, *Dunstaniidae*; *5*, *Eurymelidium*, *Mesojassus* and *Triassojassus*; *6*, *Mesoscytina*, *Mesodiphthera* and *Triassoscarta*; *7*, *Ipsvicia*; *8*, *Mesocixiinae*; *9*, *Triassopsylla*; *10*, *Archijassus*; *11*, *Procercopis*; and *12*, *Fulgoridium*.

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LETTERING OF TEXT-FIGURES.

amb, ambient vein; 1A, first anal vein; 2A, second anal vein; Cu, cubitus; Cu_1, first cubitus; Cu_{1a}, its upper, and Cu_{1b}, its lower branch; Cu_2, second cubitus or vena dividens; M, media; M_1, M_2, M_3, M_4, its branches; *mc*, median cell; R, radius; R_1, R_2, R_3, R_4, R_5, its branches; *rc*, radial cell; Sc, subcosta; Sc_1, Sc_2, its branches.

CORRIGENDA:—The following alterations need to be made in No. 6 of this series of papers (These Proceedings, xliv., 1919 Part 2, pp. 358-382; Text-figs. 29-40):—

p. 373, last line but one—*for* "*S. blabelloides*, n.sp." *read* "*S. blattelloides*, n.sp."

p. 377, line 11—*for* "SAMAROBLATTA BLABELLOIDES, n.sp." *read* "SAMAROBLATTA BLATTELLOIDES, n.sp."

p. 378, Text-fig. 37—*for* "*Samaroblatta blabelloides*, n.sp." *read* "*Samaroblatta blattelloides*, n.sp"

p. 378, last line—*for* "*Blabella* Caudell" *read* "*Blattella* Caudell."

All the above being typographical errors, Article 19 of the International Rules may be applied in the first three cases. The author therefore takes this, the first opportunity, of altering the specific name *blabelloides* to its correct form *blattelloides*.

R. J. T.

From the Proceedings of the Linnean Society of New South Wales, 1921, Vol. xlvi., Part 2, 27th July, 1921.

MESOZOIC INSECTS OF QUEENSLAND.

No. 8. Hemiptera Homoptera (Contd.). The Genus Mesogereon; with a Discussion of its Relationship with the Jurassic Palaeontinidae.

By R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.L.S., F.E.S., Entomologist and Chief of the Biological Department, Cawthron Institute, Nelson, N.Z.; formerly Linnean Macleay Fellow of the Society in Zoology.

(With Plates xvi.—xxi. and seven Text-figures).

The genus *Mesogereon* was first proposed by me (1916, p. 33), for the reception of a fragment of a very remarkable forewing from the Upper Trias of Ipswich, Queensland. The name was chosen because of a certain amount of resemblance between the fragment and the well known Permian fossil *Eugereon boeckingi* Dohrn (1867), which Handlirsch (1908, p. 389) has placed alone in a new Order Protohemiptera. The name which I gave to this Upper Triassic wing-fragment was *Mesogereon neuropunctatum,* the specific name being an allusion to the remarkable formation of cross-ridges running between the main veins, and interrupted midway by an unridged area carrying strongly marked tubercles or macrotrichial sockets. This formation was interpreted as being that of a series of original cross-veins, or *archedictyon,* in process of reduction. The condition of the fossil in this respect was held to indicate that it represented an intermediate stage between Handlirsch's Fossil Order Protohemiptera and his Palaeohemiptera, and a doubt was expressed as to whether two distinct Orders should be maintained. Later evidence obtained from a study of other fossil Hemiptera has already convinced me (1918) that Handlirsch's Palaeohemiptera should be considered as only a Sub-order of the Order Hemiptera, while the Protohemiptera, as represented by *Eugereon,* stand out so distinctly that they must certainly be maintained as a good Order. *Mesogereon* itself was placed by me in the Order Protohemiptera, since it appeared probable, from the venation preserved in the fragment, that the complete wing, when discovered, might have a venational scheme not unlike that of *Eugereon.*

In the two consignments of Ipswich fossils received by me from Mr. Dunstan since my first paper was written, there is a considerable amount of material belonging to the genus *Mesogereon.* This includes no less than three forewings,

one of them in a magnificent state of preservation, and two fragments of hindwings. The type of wing represented by this material turns out to be very different from what I had surmised on the basis of the original fragment. They are evidently the wings of true Homoptera, but so unlike any known forms that I was for a long time in doubt as to where to place them, and finally decided to allot a separate Part to them, so as to allow of a full discussion of their true affinities. In this study I have had the good fortune, during my recent voyage round the world, to see for myself, and to study carefully, the types of two of the Jurassic fossils of the family *Palaeontinidæ,* viz. *Palaeontina oolitica* Butler and *Eocicada lameerei* Handl., together with a number of undescribed specimens of this family from Solenhofen, which are in the Collection of the Museum of Comparative Zoology at Cambridge, Mass., U.S.A. This family has been placed by Handlirsch in the Order Lepidoptera. As will be shown in this paper, they are, as a matter of fact, a family of extinct Homoptera related to the Cicadas, as Oppenheim and Haase originally considered some of them to be. The genus *Mesogereon* is closely related to these Jurassic insects, and through them to the existing Cicadas also.

A careful study of the four forewings of *Mesogereon* (inclusive of the original fragment) shows that there are so many important differences that no two of them can be considered as conspecific. The original type of the genus, *Mesogereon neuropunctatum* Till., bears the number 19*a* of the Collection of Ipswich Fossils in the Geological Survey at Brisbane. The next specimens to be received were Nos. 206*a* and 207*a*. Of these, the former is a fairly complete forewing, with some of the apical border missing, and many of the main veins badly buckled at about two-thirds their lengths. This wing will be described as *Mesogereon affine,* n.sp. in this paper. No. 207*a* appeared to be, at first sight, an entirely different and much smaller wing. It was found only a few inches away from No. 206*a,* in the same layer of shale. After making careful drawings of this wing, which is by no means complete, I was struck with the fact that it possesses several peculiarities closely comparable with those to be found in the forewings of *Mesogereon,* and quite unlike anything else known in the Ipswich fossils. I therefore concluded that this specimen was part of the hitherto unknown hindwing of this genus. As it was found so close to No. 206*a,* I have decided to consider it as the hindwing of *M. affine,* n.sp., though, of course, it is impossible to prove this strictly, as the two wings were not attached *in situ* to the body of one insect.

Just before I left Australia in April, 1920, Mr. Dunstan forwarded me the remainder of the material dealt with in this paper. This consisted of three specimens numbered 169, 144*a* and 97 respectively. No. 169 is a magnificent wing, complete except for a small piece missing from the costal margin and another small piece from the apex. Its state of preservation is so perfect that even the impressions of some of the hairs carried by the macrotrichial sockets on the wing-membrane are visible, and have been most beautifully photographed by Mr. W. C. Davies in Plate xvii., fig. 19. The ambient vein and coriaceous border (Plate xviii., fig. 20), typical of the Homoptera, are here, for the first time, shown in their perfection, leaving no doubt as to the correct placing of these insects in the Order Homoptera. This wing is here described under the name *M. superbum,* n.sp. No. 97 is a hindwing, more complete than No. 207*a*. It shows, for the first time, a small portion of the ambient vein and coriaceous border (Plate xxi., fig. 25) resembling those of the forewing, and thus definitely settling the question as to the genus to which these two wings belong.

This wing may possibly be the hindwing of *M. superbum;* but, in the absence of any direct evidence, I have considered it necessary to give it a separate name. It will therefore be here described as *M. shepherdi,* n.sp. after Mr. S. R. L. Shepherd, an energetic officer of the Queensland Geological Survey, who unearthed many of these fossil insects. No. 144*a* is a nearly complete forewing, not very well preserved, and with the main veins somewhat crushed and compressed together. It will be described as *M. compressum,* n.sp.

The original definition of the genus *Mesogereon* given by me on the characters shown in the type fragment now appears quite inadequate, and will be greatly added to in this paper.

The photographic enlargements shown in the Plates are all the work of Mr. W. C. Davies, Curator of the Cawthron Institute, to whom my best thanks are due for such remarkably fine illustrations of these interesting fossils.

Descriptions of the Fossils.

Order **HEMIPTERA.**

Sub-order **Homoptera.**

Family MESOGEREONIDAE, fam. nov.

Large, Cicada-like insects, without sound-producing apparatus. Forewings greatly elongated, little more than one-fourth as wide as long; clavus less than one-fourth the wing-length, very narrow; rest of wing with the main veins diverging gently from one another at regular intervals across the wing; a few cross-veins present in the basal third, but the rest of the wing entirely devoid of such; ambient vein and coriaceous border complete from above apex round to distal end of clavus. Hindwings short and broad, only half as long as forewing or less; main veins diverging regularly across the wing, with no cross-veins in the distal half; ambient vein and coriaceous border present as in forewing. In the forewing, Sc, R and Rs are all placed close together near the costal border; from Cu_1 a long anterior branch (*m-cu*) arises near the base and runs distad to meet M_4 a little beyond its point of origin. In the hindwing, Sc, R and Rs are more normally placed, and *m-cu* is not elongated. Except on the clavus, which is smooth, the forewing is remarkable for the regularly arranged cross-ridges between the main veins; each of these ridges is interrupted in the middle by an area carrying strongly tuberculate macrotrichial sockets, from which stiff hairs project distad (Plate xvii., fig. 19). These structures are absent from the hindwing, which is covered all over with much finer and more closely arranged pits, each of which probably carried a very fine hair.

Closely related to the Jurassic *Palaeontinidae,* from which they differ chiefly in the shape and sculpture of the wings. Also related more remotely to the existing *Cicadidae,* in many of which the remains of the regular cross-ridging of the forewing can still be seen, but in which the main veins in the distal part of the wing are always connected by strong cross-veins.

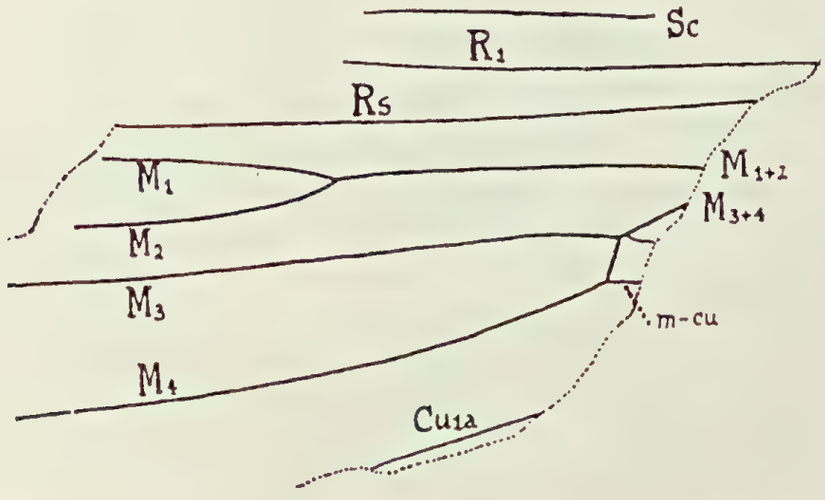
Genus Mesogereon Tillyard.

Tillyard, Mesozoic and Tertiary Insects of Queensland and New South Wales, Queensland Geol. Survey, Publ. No. 253, 1916, p. 33.

The definition of this genus can now be amended as follows:—To the characters given for the family add the following venational details:—*Forewing*: Rs arising close to base and dividing at less than one-fourth of the wing-length into

two closely parallel branches, which later on diverge somewhat towards the apex; both of these branches remain simple. M four-branched, its main stem weakly formed; M_4 arises obliquely downwards from M_{3-4} at a point nearer the base than is the forking of M_{1-2}, and shortly after receives from Cu_1 a long branch, *m-cu,* and then turns to run longitudinally in line with the course of *m-cu.* Thus between R+M and the weak main stem of M above, M_{3-4} and the basal piece of M_4 distally, and Cu_1 and *m-cu* below, a closed cell is formed, which we shall call the *medio-cubital cell.* In this cell lie the remains of an irregular and weak meshwork or archedictyon, which varies according to the species. Cu with very weak main stem, dividing quite close to the base into Cu_1 and Cu_2. Cu_1 gives off first the already mentioned branch *m-cu,* and then divides into two main branches Cu_{1a} and Cu_{1b}, both of which reach the wing-margin. Cu_2 becomes the *vena dividens,* separating the clavus from the rest of the wing, and lying in a deep groove close to 1A, except at its distal end, where it diverges from 1A considerably. Clavus with two distinct, unbranched veins, 1A and 2A, the former straight, the latter curved, and arising from the posterior border of the wing near its base. Cross-veins present are only *r-m,* the elongated *m-cu* (possibly a true branch of Cu_1), the irregular meshwork in the medio-cubital cell, and sometimes *cu-a. Hindwing*: Rs arising at from one-fourth to one-third along the wing, unbranched, or perhaps sometimes branched distally. M only three-branched. Cu_1 two-branched; Cu_2 a weak vein arising far along Cu, and becoming obsolete long before reaching the wing-margin. (Anal veins not well preserved, two or possibly three). Cross-veins present are only *r-m, m-cu* (short in this wing) and *cu-a,* with sometimes *sc-r* and another *r-m* situated more basally between the main stems of R and M.

Genotype, *Mesogereon neuropunctatum* Till. (Upper Triassic, Ipswich, Q.).



Text-fig. 65.—*Mesogereon neuropunctatum* Tillyard. Details of venation in forewing. (x $6\frac{3}{4}$).

Mesogereon neuropunctatum Till. (Pl. xxi., fig. 24; Text-fig. 65.)

Tillyard, Q'land Geol. Surv., Pub. 253, p. 34, Plate i., Figs. 1, 2.

A fragment of a forewing, measuring 23 mm. greatest length by 17 mm. greatest breadth. Studied in the light of the new material, this fragment is found to consist of a small portion of a very large wing, probably between 50 and 60

mm. long and with a greatest breadth of 15 mm. or more. Portions of all the veins from Sc to Cu_{1b} are preserved, but the wing is broken about the middle of the preserved portion of Sc, so that this vein, R_1, Rs, M_1 and M_2 are all badly bent. Origin of Rs not visible. Forks of M_{1-2} and M_{3-4} are both clearly preserved, the distance between them being 4 mm. The bent basal piece of M_4 lies just within the basal edge of the fragment, and is 0.6 mm. long. These measurements are useful for comparison with the wings of the other species. In Fig. 1 of my original description of this wing, the vein marked C is Sc, Sc is R_1, R is Rs, the two veins marked M are M_1 and M_2 respectively, while the two marked Cu are M_3 and M_4. Below these, crossing the posterior angle of the fragment, are a shorter piece of Cu_{1a}, and a minute portion of Cu_{1b}, the latter labelled A in the figure.

The cross-ridging of the main veins, and the tuberculated areas lying between them, are fairly well shown, as may be seen from a study of Plate xxi., fig. 24, of this paper.

Type, Specimen No. 19*a*, in Coll. Queensland Geol. Survey, Brisbane, Q. *Type-counterpart,* Specimen No. 19*b* in same collection.

Horizon, Upper Triassic, Ipswich, Q.

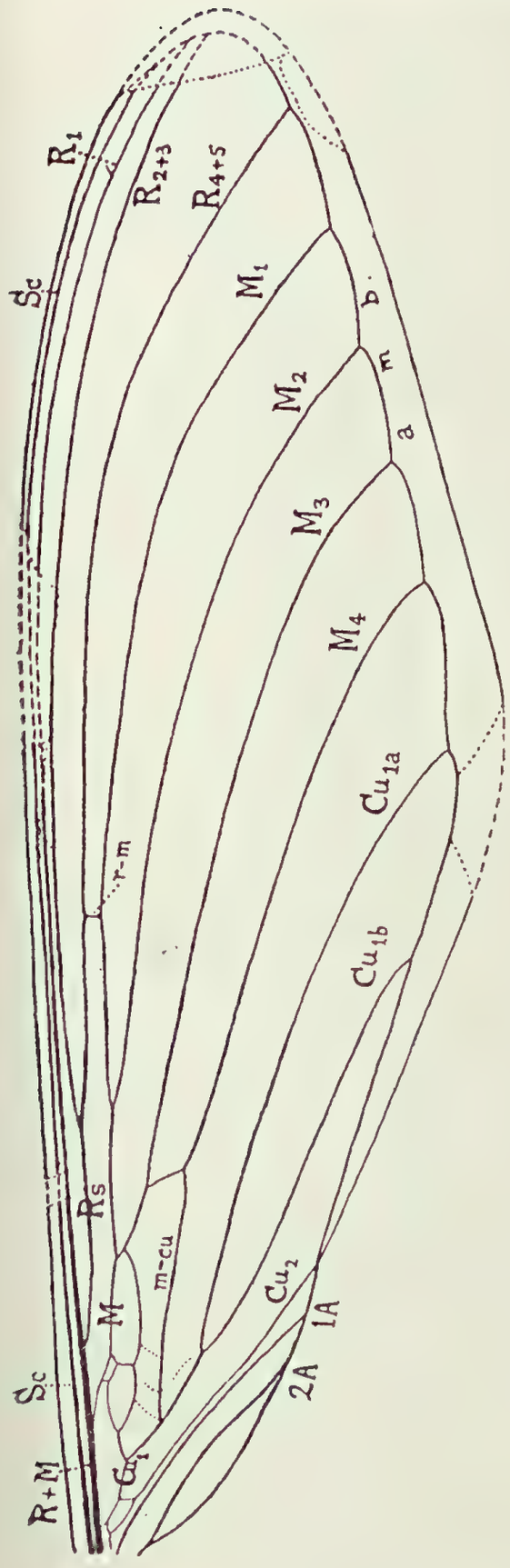
Mesogereon superbum, n.sp.

(Text-figs. 66, 67, and Plates xvi., xvii., xviii., Figs. 18—20.).

A remarkably preserved forewing, complete except for a portion of the costal margin and a small piece missing from the extreme tip. *Greatest length,* 44.5 mm., representing a wing about 46 mm. in total length. *Greatest breadth,* 12 mm., which is also the greatest breadth of the complete wing.

The scheme of the venation is shown in Text-fig. 66. The wing is long and narrow, the costal margin straight from base to half-way, and then very slightly convex. The extreme apex is missing, but appears to have been moderately rounded, or perhaps very slightly pointed. Posteriorly, the wing margin shows a very obtuse angulation about half-way, this angle being the *tornus,* separating the true *dorsum,* or basal portion of the posterior margin, from the *termen,* or part lying between apex and tornus. R_{2-3} runs to apex, and Cu_{1a} ends up just above the tornus. Sc and R_1 are crowded together close up to the costal margin for their whole lengths, diverging very slightly indeed towards the apex. R and M are fused together for a short basal stretch, after which M separates off as a very weakly indicated vein, supported beneath by the irregular meshwork of the medio-cubital cell described below. A little beyond the origin of M, Rs separates off from R as a strong vein running just below R_1, and dividing into R_{2-3} and R_{4-5} at a point about one-fourth of the wing-length from the base. R_{2-3} runs close under R_1 for some distance, then diverges very slightly from it in the distal half of the wing, and finally converges towards it again very slightly near the apex, where it ends. This vein remains unbranched throughout. R_{4-5} diverges slightly from R_{2-3} at its origin, and then runs sub-parallel to it for about half its length. More distally, it diverges considerably from R_{2-3}, and ends up some distance below the apex. At about two-fifths of the wing-length from the base, R_{4-5} is connected with M_1 by a short but well marked crossvein, *r-m;* slightly basad from this there is an appearance of a second, much more weakly formed cross-vein, indicated by the dotted line in Text-fig. 66.

At about one-fifth of the wing-length from the base, M forks dichotomically into two main branches. The upper of these, M_{1-2}, runs to a point just distad



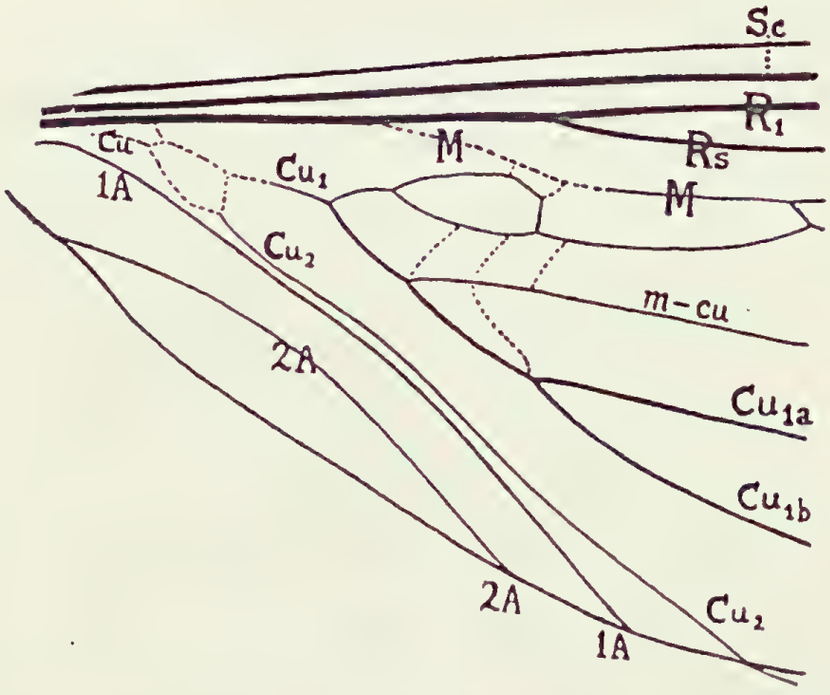
Text-fig. 66.

Mesogereon superbum, n.sp. Venation of forewing. (x 3¼).

from the level of the origin of Rs, and then forks again dichotomically into M_1 and M_2. The lower, M_{3-4}, runs only about half the distance of the upper, and then forks uniserially, M_3 continuing the line of M_{3-4}, while M_4 diverges sharply posteriad for a short distance, until it meets a longitudinal branch from Cu_1 (*m-cu*); it then turns distad so as to continue the line of *m-cu*. From this point on, the wing is divided evenly by the series of very slightly diverging veins M_1, M_2, M_3 and M_4, with the branches of Rs continuing the series anteriorly, and the branches of Cu_1 posteriorly. Distance between fork of M_{1-2} and fork of M_{3-4}, 2.5 mm.; length of basal piece of M_4, 1.2 mm. The *medio-cubital cell* is closed basally by a short weak cross-vein descending from R+M on to the very weakly formed main stem of Cu (both of these being barely visible), and ends distally at the basal piece of M_4. Within it is to be seen the peculiar and very irregular formation of veinlets shown in Text-fig. 67. These consist of a fairly strongly marked curved longitudinal vein running from Cu_1 very close to the base to join M_{3-4} slightly distad from its origin. This vein is divided, just before half-way, by a transverse vein above it, which forms the distal boundary of a small closed cell lying just below M, and connected with it by two very short and weak cross-veins; the small cell is completed by a convex vein above, arising from the long vein already mentioned at a point slightly distad from its origin. Below this small cell are two oblique cross-veins, weakly formed, with a third similar cross-vein descending from the long vein on to *m-cu* just distad from them. This peculiar formation should be compared with the simpler formation to be met with in the same area of *M. affine*, n.sp.

The very weakly formed basal piece of Cu forks quite close to the base into Cu_1 and Cu_2 (Text-fig. 67), both of these being weakly indicated for a short distance, until they are connected by a weak cross-vein. Beyond that point, they begin to strengthen, Cu_1 soon becoming a very strong convex vein, which

gives off, anteriorly, the long connecting vein *m-cu,* already mentioned in connection with M_4, and then divides into Cu_{1a} and Cu_{1b} at a point level with the origin of Rs; these two veins run in a gentle curve to the wing-border, Cu_{1a} ending up above the tornus, Cu_{1b} more basally on the dorsum. Cu_2 lies in a deep groove in the anal furrow, forming the *vena dividens,* with its apex at the termination of the *coriaceous border.*



Text-fig. 67.—*Mesogereon superbum*, n.sp. Venation of base of forewing. (x 6¾).

The *clavus* is short and narrow, ending distally at a point about level with the first forking of M. There are only two anal veins, of which 1A is nearly straight, and runs very close up to Cu_2, except distally, where these two veins diverge, while 2A forms a very flat loop, arising and ending on the posterior border of the clavus.

The whole of the wing between the radius and the clavus carries the cross-ridges and flat tuberculated areas typical of the family. These are well shown in Mr. Davies' beautiful photographs reproduced in Plates xvi.—xviii., figs. 18, 19, 20. That the tubercles were the swollen sockets of macrotrichia is well seen by a study of the enlargement in Plate xvii., fig. 19, in which the impressions of the hairs can be very clearly seen, especially in the forks between M_{1-2} and M_3, and between M_3 and M_4.

From just above the apex of the wing right round the termen and dorsum to the distal end of the clavus, there is a well preserved *coriaceous border,* separated from the rest of the wing by the *ambient vein* (*amb.*). This border shows a definite cross-ridging of considerably smaller calibre than that shown along the main veins, as may be seen from a study of Plate xviii., fig. 20. The coriaceous border in the wings of recent *Cicadidae* shows a similar cross-ridging, but the ridges stand much further apart. The ambient vein (*amb.*) forms a series of slight bays between the ends of each pair of consecutive main veins, much as in the case of recent *Cicadidae,* but with the individual bays not so strongly formed.

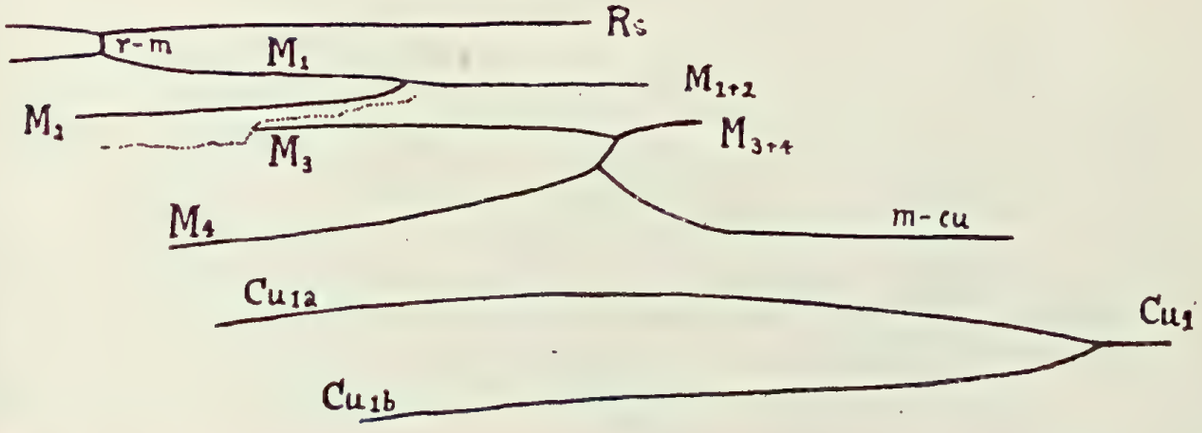
Type, Specimen No. 169, in Coll. Queensland Geol. Survey, Brisbane, Q.
Horizon, Upper Triassic, Ipswich, Q.

Of all the fossils so far found at Ipswich, this wing is perhaps the most perfectly preserved as regards the minute structure of the veins and membrane.

MESOGEREON COMPRESSUM, n.sp. (Text-fig. 68.)

A nearly complete but very poorly preserved forewing, in which the longitudinal veins have been compressed together to some extent, especially from the costa down to M_3. *Greatest length,* 42 mm., representing a total length of about 45 mm. *Greatest breadth,* only 8 mm., representing a true wing-breadth of about 12 mm.

The extreme base of this wing is missing, owing to a diagonal break from near the base of *m-cu* up to and including the first fork of M. The whole of the clavus is absent, and also a narrow strip along the termen, including the coriaceous border. Text-fig. 68 shows a portion of the wing, including the cross-vein *r-m* and the forks of M_{1-2}, M_{3-4} and Cu_1. The cross-vein *r-m* is very short, each of the two main veins Rs and M_1 being curved in slightly at this point, and then diverging slightly again distad. As a result of compression, together with, per-



Text-fig. 68.—*Mesogereon compressum*, n.sp. Details of venation of forewing. (x $6\frac{3}{4}$).

haps, a longitudinal split, the space between M_2 and M_3 has become greatly lessened; and M_3, lying at a lower level than M_2 on the rock surface, disappears under the slight ridge on which this latter vein lies. Distance between fork of M_{1-3} and fork of M_{3-4}, 2.9 mm. (possibly a little more in the uncompressed wing); length of basal piece of M_4, 0.6 mm. Cross-ridges clearly marked, tuberculation weak.

Type, Specimen No. 144*a*, in Coll. Queensland Geol. Survey, Brisbane, Q. *Type-counterpart,* specimen No. 144*b*, in same collection.

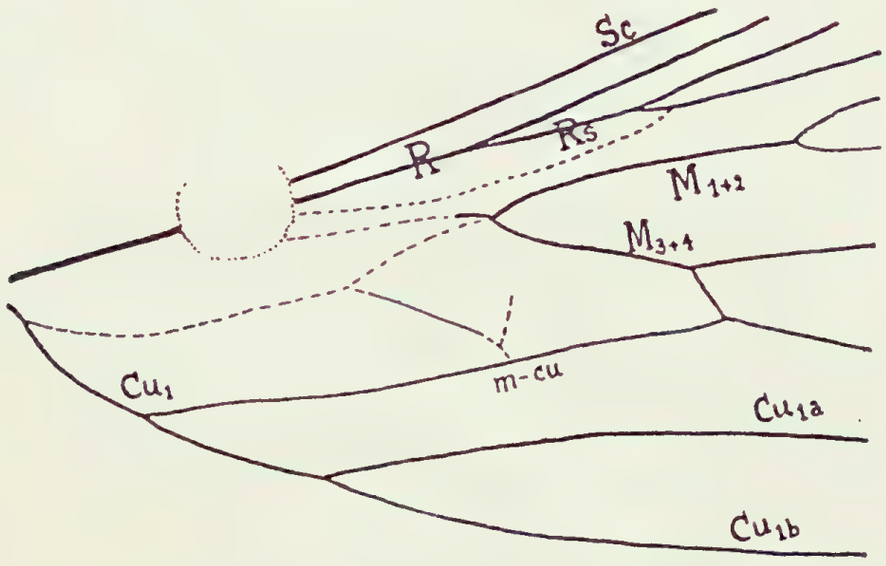
Horizon, Upper Triassic, Ipswich, Q.

MESOGEREON AFFINE, n.sp. (Text-figs. 69, 70, Plates xix., xx., Figs. 21, 22.)

Specimen No. 206*a* represents a nearly complete forewing with most of the termen missing, and with all four branches of M broken along an oblique line in the distal part of the wing, so that their distal ends bend downwards at a well marked angle. *Greatest length* of fragment, 35 mm., representing a total length of wing of about 40 mm. *Greatest breadth,* 11.5 mm., representing a total width of about 12 mm.

Text-fig. 69 shows the well preserved basal portion of this wing, excluding the clavus. A small round hole made by a sharp instrument near the base of R is indicated by the finely dotted circle. It will be seen that the origin of

Rs is at the same level as the first fork of M, while the fork of Rs is at the same level as the origin of M_4. Distance between fork of M_{1-2} and fork of M_{3-4} 2.5 mm.; length of basal piece of M_4, 1.2 mm. In the medio-cubital cell, the



Text-fig. 69.—*Mesogereon affine*, n.sp. Venation of base of forewing. (x 6·4).

remains of the archedictyon consist only of the long vein running from near the base of Cu_1 to the fork of M, together with a vein descending obliquely from it on to *m-cu;* from near the lower end of this latter vein, a short broken stump runs upwards towards M_{3-4}, but ends half-way across the cell. There is also a weakly formed veinlet running longitudinally in the space between R and M, and ending on Rs just distad from its origin. Cross-ridging very distinct; tuberculation moderately well preserved.

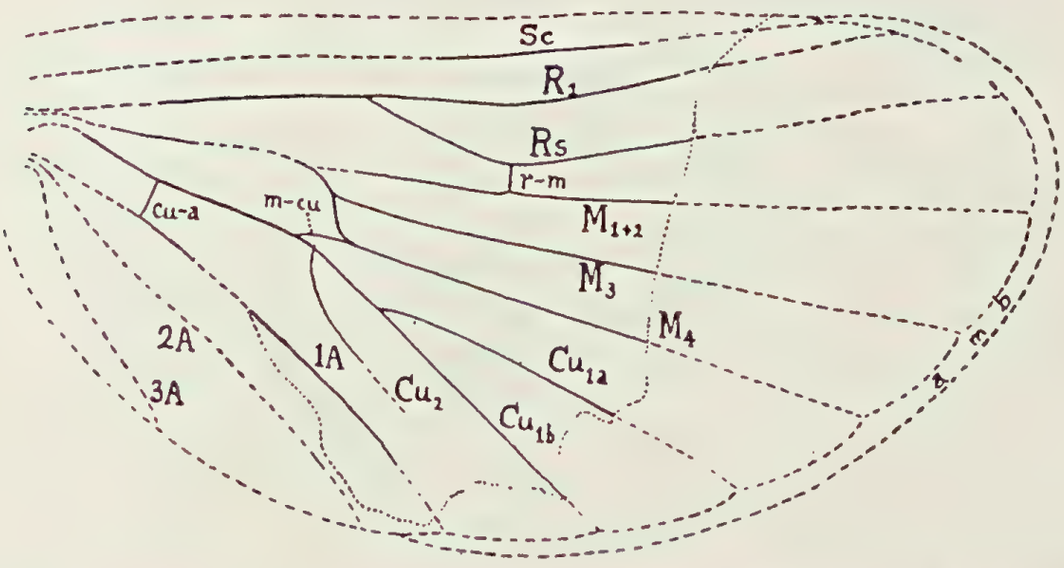
Type, Specimen No. 206*a*, in Coll. Queensland Geol. Survey, Brisbane, Q. *Type-counterpart,* specimen No. 206*b*, in same collection.

Horizon, Upper Triassic, Ipswich, Q.

Specimen No. 207*a* was found not far from No. 206, and is shown in Plate xx., fig. 22. Text-fig. 70 shows a drawing of the preserved parts of the venation, with the rest of the wing restored by broken lines. The close resemblance to the venation of the hindwing of a Heteroneurous Moth will be at once evident. I was for a long time in doubt as to whether this wing did not really belong to the Lepidoptera. The absence of any portion of the termen, from which it might be determined whether a coriaceous border was present or not, made the problem a difficult one. But finally a portion of the border was discovered in another closely similar hindwing (No. 97). This discovery made it certain that both specimens No. 97 and No. 207*a* were hindwings belonging to the genus *Mesogereon.* Specimen No. 207*a* is here considered to be the hindwing of *M. affine,* as it was found so close to the forewing of that species.

Comparing the hindwing with the fore, it will be seen at once, from the more normal positions of Sc and R, that the hindwing was considerably broader than the fore in comparison with its length. The preservation of part of the distal border in No. 97 enables us to estimate very closely the actual shapes of these wings, which are then seen to bear very much the same relationship to the forewings that those of a recent Cicadid do to their corresponding forewings. Rs arises a little beyond one-third of the wing-length, and runs obliquely downwards

until, at about half-way along the wing, it is joined to M_{1-2} by the short cross-vein *r-m*, closely resembling that of the forewing. The basal part of M is weakly formed; it divides unilaterally into M_{1-2} above, continuing the course of M, and M_{3-4} below; this latter vein proceeds obliquely downwards a very short distance, and then divides into M_3 and M_4, the former running straight through the wing to



Text-fig.70.—*Mesogereon affine*, n.sp. Venation of hindwing. Missing portions restored by broken lines. For lettering, see p. 284. (x 4½).

the middle of the termen, the latter curving downwards to meet a short branch from Cu_1 (*m-cu*), and then turning to run sub-parallel to and beneath M_3 to the termen. Cu is clearly marked, and is joined to 1A by means of a strong cross-vein *cu-a*. What appears to be the true Cu_2 is a weakly formed furrow-vein arising just beyond the origin of *m-cu*, and soon becoming obsolescent; it fails to reach more than half-way to the wing-border. Cu_1 continues the line of Cu with a slight bend downwards, and soon forks into Cu_{1a} and Cu_{1b}, which diverge to run straight to the wing-border. 1A appears to be well developed; the rest of the clavus is missing. *Greatest length*, 11 mm. *greatest breadth*, 9 mm., representing a wing of about 21 mm. total length by 11 mm. breadth.

This wing is very finely pitted all over, each minute pit having been apparently the socket of a small hair. There are no cross-ridges on the main veins.

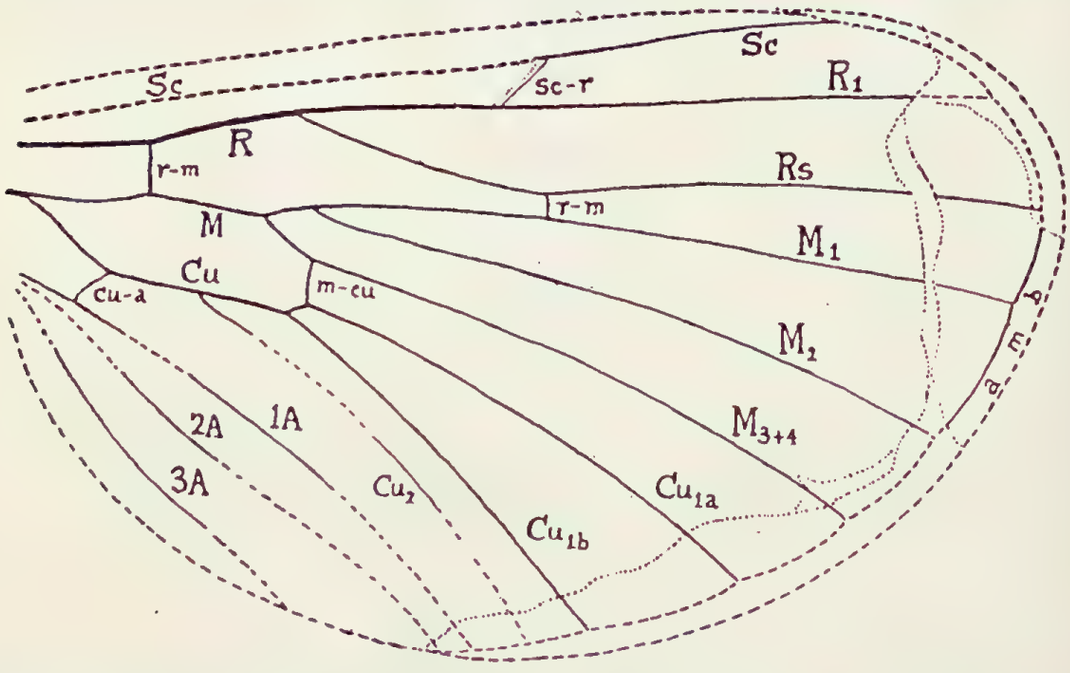
T y p e, Specimen No. 207*a*, in Coll. Queensland Geol. Survey, Brisbane, Q. *Type-counterpart*, specimen No. 207*b*, in same collection.

MESOGEREON SHEPHERDI, n.sp. (Plate xx., Fig. 23, and Text-fig. 71.)

This species is represented by a hindwing only, complete except for the absence of the costal border, a small piece around the apex, the lower portion of the termen, and most of the clavus. *Greatest length*, 21 mm., *greatest breadth*, 11 mm., the former representing practically the full length of the wing, the latter indicating a total breadth of about 13 mm.

Structure and venation generally similar to those of the hindwing of *M. affine* described above, but with the following differences:—R is connected with M close to the base by a strong cross-vein, *r-m*. About half-way along the wing, R is also connected with Sc by an oblique cross-vein, *sc-r*. Rs arises closer to the base than in *M. affine*, but the cross-vein *r-m* which corresponds with that in *M. affine* remains in the same position about half-way along the wing; consequently the piece of Rs from origin to cross-vein is longer in *M. shepherdi*, and

the bend at the cross-vein less marked. M is three-branched, but it is the upper branch, M_{1-2}, which divides into two, while the lower, M_{3-4}, appears to run straight to the termen. Cu_1 divides into two at a level slightly distad from that



Text-fig. 71.—*Mesogereon shepherdi*, n.sp. Venation of hindwing. Missing portions restored by broken lines. For lettering, see p. 284. (x 4½). Note the presence of two radio-median crossveins, *r-m*.

of the first fork of M; the upper branch, Cu_{1a}, is connected with M_{3-4} by a strong cross-vein. (It would be possible to interpret this cross-vein as the basal piece of M_4; in which case M would become four-branched and Cu_1 simple in this species; it is not easy to say which interpretation is really the correct one). The origin of Cu_2 is not clear, but appears to be about half-way between *cu-a* and the forking of Cu_1. The cross-vein *cu-a* is present near the base, but somewhat more oblique than in *M. affine*.

Cross-ridges are absent on the main veins, but clearly present on the coriaceous border, a portion of which is preserved between the ends of veins Rs and M_2. This part of the wing is shown much enlarged in Plate xxi., fig. 25.

Type, Specimen No. 97 in Coll. Queensland Geol. Survey, Brisbane, Q.

Horizon, Upper Triassic, Ipswich, Q.

Table of Some Important Differences in the Forewings of the Known Species of Mesogereon.

	Measurements (in mm.).	*M. neuropunctatum.*	*M. superbum.*	*M. compressum.*	*M. affine.*
(1).	Estimated total length.	50 - 60	46	45	40
(2).	Estimated total breadth.	15 - 17	12	12	12
(3).	From fork of Rs to fork of M_{1+2}.	—	0·9	—	2·3
(4).	From fork of M_{1+2} to fork of M_{3+4}.	4·0	2·5	2·9	2·4
(5).	Basal piece of M_4.	0·6	1·2	0·6	0·9
(6).	Angle of M_4 to fork of Cu_1.	—	5·7	6·3	6·0
(7).	Ratio of (4) to (5).	6·7	2·1	4·8	2·7
(8).	Ratio of (6) to (5).	—	4·7	10·5	6·7

Discussion of the Relationship of the Genus Mesogereon with the Jurassic Palaeontinidae.

In my work on the Panorpoid Complex, I followed Handlirsch in considering the Jurassic family *Palaeontinidae* as belonging to the Order Lepidoptera (1908, pp. 654-8). I pointed out, however, certain characters which prevented us from assigning them to either of the two Sub-orders of the Lepidoptera existing to-day, and suggested that they should be considered as a separate Sub-order Palaeontinoidea.

It is, of course, well known that both Oppenheim (1888) and Haase (1890) considered certain of the *Palaeontinidae* which they described to be Homoptera related to the *Cicadidae;* viz., the genera *Prolystra, Beloptesis* and *Eocicada.* Others were placed in the Lepidoptera, viz. *Phragmatoecites* and *Palaeocossus.* Butler placed the well known forewing of *Palaeontina oolitica* in the Lepidoptera. Thus there was, from the first, considerable doubt about the correct position of these fossils. Handlirsch, after studying many of the type-specimens and describing other new species, summed up his conclusions as follows (1908, p. 619, translated from the original German) :—

(1) In several of these fossils the covering of scales on the wings is quite plainly visible.

(2) The *Limacodidae* just mentioned do not visit flowers, and are, no doubt, old forms whose mouth-parts remain at an archaic stage of development, similar to the *Hepialidae,* etc. (N.B. Handlirsch claims a close affinity between the *Palaeontinidae* and the existing *Limacodidae.*).

(3) The resemblance of these fossils to the Cicadas is only a very superficial one, and their venation can in no way be traced back to that of the Homoptera.

(4) The venation of the fossils is strikingly similar to the course of the tracheae in many pupae of recent Lepidoptera.

At the time when I discussed this family in the Panorpoid Complex, I had not, of course, seen any of the actual fossils, and had been content to accept Handlirsch's statement, that the covering of scales could be quite plainly seen in some of them. However, during my recent voyage round the world, I studied all those *Palaeontinidae* to which I could get access, and was surprised to find myself quite unable to agree with Handlirsch's conclusions. The results which I obtained may be briefly stated as follows:—

(1) The original type of *Palaeontina oolitica* Butler was studied by me in the Geological Museum, Jermyn Street, London. This is a very badly preserved impression of a forewing, from which it would be quite unsafe to draw any definite conclusions. It is clear, however, that M has four quite distinct branches, which occupy most of the distal portion of the wing, so that the branches of R, which are indistinct, are pushed up towards the costal margin. There is no sign of the formation of a Y-vein between M_4 and Cu_{1a}. Thus, in so far as this specimen offers any evidence at all, it is *not* in favour of any Lepidopterous affinity. (No sign of scales can be seen, but this could not be expected in so poorly preserved material.).

(2) Professor Lameere, of Brussels, kindly handed to me for study the original type of *Eocicada lameerei* Handl. With respect to this insect, Handlirsch has stated definitely that he could see the scales on the wings (1908, p. 627, "Am mehrerer Stellen haben die Schuppen ganz deutliche Eindrucke auf der Platte hinterlassen"). The specimen is only moderately well preserved, like most of the insects from the Solenhofen Beds. Handlirsch's photographic repro-

duction (1908, Atlas, Plate 1, fig. 11) scarcely does justice to it, and a careful study of the fossil under low powers of the microscope soon reveals some characters of unexpected interest. With respect to the wings, I searched most carefully for evidence of scales all over them, but have to confess that I could see no sign of them, though the peculiar semi-glazed and flattened grain of the rock might mislead one into thinking that scales were present. But I did discover, in a number of places, distinct evidence of the presence of comparatively large tubercles in the areas midway between the main veins. These tubercles closely resemble those of *Mesogereon* in size, number and arrangement. The fact of their presence makes it quite certain that scales are *not* present. I next searched for signs of the transverse ridging of the main veins, but failed to find any indication of this. Finally, following round the margin of the forewing, I looked carefully for signs of a coriaceous border, with the result that I am able to state definitely that such a border did exist in this fossil, as clear signs of it can be seen in several places, by the use of careful lighting. Turning next to the body, it was possible to make out fairly definite indications of hairiness on the abdomen. The head is certainly not as small as Handlirsch supposes. The part which he takes for the whole head is only a small projecting frontal shelf, much like that of recent Cicadas. On either side of this there can be seen a largish oval depression, which is surely that of the compound eye. These two eyes, then, are large and stand wide apart, like those of recent Cicadas. Projecting on either side between the eye-depression and the frontal shelf, there can be seen faintly a short projecting filament, which is almost certainly the impression of the antenna, and corresponds exactly in shape and position with the antenna of a true Cicada.

The venation of this fossil, as far as it is preserved, closely resembles that of *Mesogereon*. Sc and R are pressed close up towards the costal margin, while little space is allotted for Rs, and there is certainly no justification for the restoration of the full four branches of Rs apically, as Handlirsch has shown them. Most of the distal area of the wing is occupied by the four very prominent branches of M, very similar to those of *Mesogereon*. M_4 has a short basal piece, and is then bent, as in *Mesogereon*, at the point where it receives a long branch from Cu_1 (the branch which I have called *m-cu*). Cu_1, after giving off *m-cu*, branches again into Cu_{1a} and Cu_{1b}, exactly as in *Mesogereon*. The hindwing is greatly reduced and poorly preserved. Two forked veins can be seen, separated by a single vein. The single vein is clearly a part of M, the main stem of this vein being clearly visible. If this vein be M_{3-4}, then the forked veins above it are probably M_1 and M_2, as in *Mesogereon shepherdi*. The forked veins below M_{3-4} are evidently Cu_{1a} and Cu_{1b}, as in *Mesogereon*.

As regards Handlirsch's remark that the venation of *Palaeontinidae* resembles the courses of the tracheae in pupal wings of recent Lepidoptera, it might with more than equal truth be said that they also resemble the courses of the tracheae in the nymphal wings of recent Cicadas.

From my study of *Eocicada lameerei*, I am forced to conclude that this fossil is a Homopteron, closely related to *Mesogereon* and less closely to the recent *Cicadidae*.

(3) There are, in the Museum of Comparative Zoology at Cambridge, Mass., a whole drawer full of Solenhofen fossils belonging to the *Palaeontinidae*. These are undescribed, but classified as Hemiptera. These fossils would well repay a fuller study than I was able to give them. Although for the most part in poor preservation, it is possible to find in them plenty of evidence in support of the Homopterous nature of the *Palaeontinidae*. None of them shows signs of scales,

but the tuberculation of the forewing is faintly indicated in places, and so is the presence of the coriaceous border.

Reviewing the above evidence as a whole, I am forced to the conclusion that Handlirsch has committed a serious error in claiming that the *Palaeontinidae* belong to the Lepidoptera, and more particularly in making the definite statement that scales are to be seen on these fossil wings. As far as the material which I studied can be considered typical of the family, there is certainly no evidence of any Lepidopterous affinities. On the contrary, the general build of the insects, the venational scheme, and what little can be discovered of the armature of the wing and the structure of the margin, leave no doubt whatever in my mind that the *Palaeontinidae* are closely related to the genus *Mesogereon,* and that both have a less close connection with recent *Cicadidae.* Though it is not possible to prove definitely that either *Mesogereon* or the *Palaeontinidae* represent the original ancestors of the Cicadas, yet we can definitely state that those ancestors must have closely resembled these fossils.

Present knowledge of the genus *Mesogereon* would lead me to abandon my former claim that they show any affinity with the Protohemiptera, as represented by *Eugereon,* though I am still prepared to see, in the cross-ridging of the main veins and the presence of a remnant of an archedictyon in the medio-cubital cell, evidences of a descent from forms possessing a complete original mesh work of weak veinlets, such as is found in most of the Carboniferous fossils.

A restoration of the complete insect belonging to the genus *Mesogereon* should show it as a Cicada-like insect having roughly-haired forewings held roof-wise over a moderately stout and probably hairy body; the hindwings smooth and transparent, hidden beneath the forewings, and probably with the anal area folded. There was no sound-producing apparatus comparable with that of recent Cicadas. The voiceless, hairy Cicadas of the genus *Tettigarcta,* confined at the present day to Victoria and Tasmania, perhaps represent the closest approach, amongst living insects, to these interesting Upper Triassic fossils, whose discovery cannot fail to add much to our knowledge of, and interest in, the Homoptera as a whole.

Cawthron Institute, Nelson, N.Z. 7.3.21.

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Note on the numbering of the figures.—The numbers of the figures in this series of papers were intended to run consecutively from Part to Part. Owing to

an inadvertence, the Text-figures of Part 7 were not so numbered. Forty should be added to the number of each Text-fig. in Part 7, so that the last one is 64, not 24. Thus this Part begins with No. 65. In the same way, the figure on the Plate accompanying Part 4 should be number 15, and the two figures on the Plate issued with the Queensland Geological Survey reprints of Part 5 should be Nos. 16 and 17.

EXPLANATION OF PLATES XVI.–XXI.

[All the plates are reproductions of photographic enlargements taken by Mr. W. C. Davies, Curator of the Cawthron Institute, by means of vertical camera extending to 42 inches, Aldis anastigmat lens (F 6·5, No. 00), and nearly horizontal electric light with condenser].

Plate xvi.

Fig. 18. *Mesogereon superbum*, n.sp. Forewing. (x 4·1).

Plate xvii.

Fig. 19. *Mesogereon superbum*, n.sp. Base of forewing. (x 10·9).

Plate xviii.

Fig. 20. *Mesogereon superbum*, n.sp. Portion of forewing, much enlarged, to show ambient vein and coriaceous border. (x 16).

Plate xix.

Fig. 21. *Mesogereon affine*, n.sp. Forewing. (x 5·65).

Plate xx.

Fig. 22. *Mesogereon affine*, n.sp. Hindwing. (x 5.6).

Fig. 23. *Mesogereon shepherdi*, n.sp. Hindwing. (x 5).

Plate xxi.

Fig. 24. *Mesogereon neuropunctatum* Tillyard. Genotype. Fragment of forewing. (x 8).

Fig. 25. *Mesogereon shepherdi*, n.sp. Portion of hindwing, much enlarged, to show a piece of the ambient vein and coriaceous border. (x 16).

LETTERING OF TEXT-FIGURES.

1A, 2A, 3A, the three anal veins. *amb*, ambient vein. Cu, cubitus. Cu_1, Cu_2, its two main branches, the former dividing into Cu_{1a} and Cu_{1b}. *cu-a*, cubito-anal cross-vein. M, media. M_{1+2}, M_{3+4}, its two main branches, of which the former divides into M_1 and M_2, the latter into M_3 and M_4. *m-cu*, medio-cubital cross-vein (in forewings of *Mesogereon* this is much elongated, and may be a true anterior branch of Cu_1). R, radius. R_1, its anterior main branch. Rs, its posterior main branch, or *radial sector*, which divides into R_{2+3} and R_{4+5}. *r-m*, radio-median cross-vein (there are two of these in hindwing of *M. shepherdi*, n.sp.). Sc, subcosta. *sc-r*, subcosto-radial cross-vein.

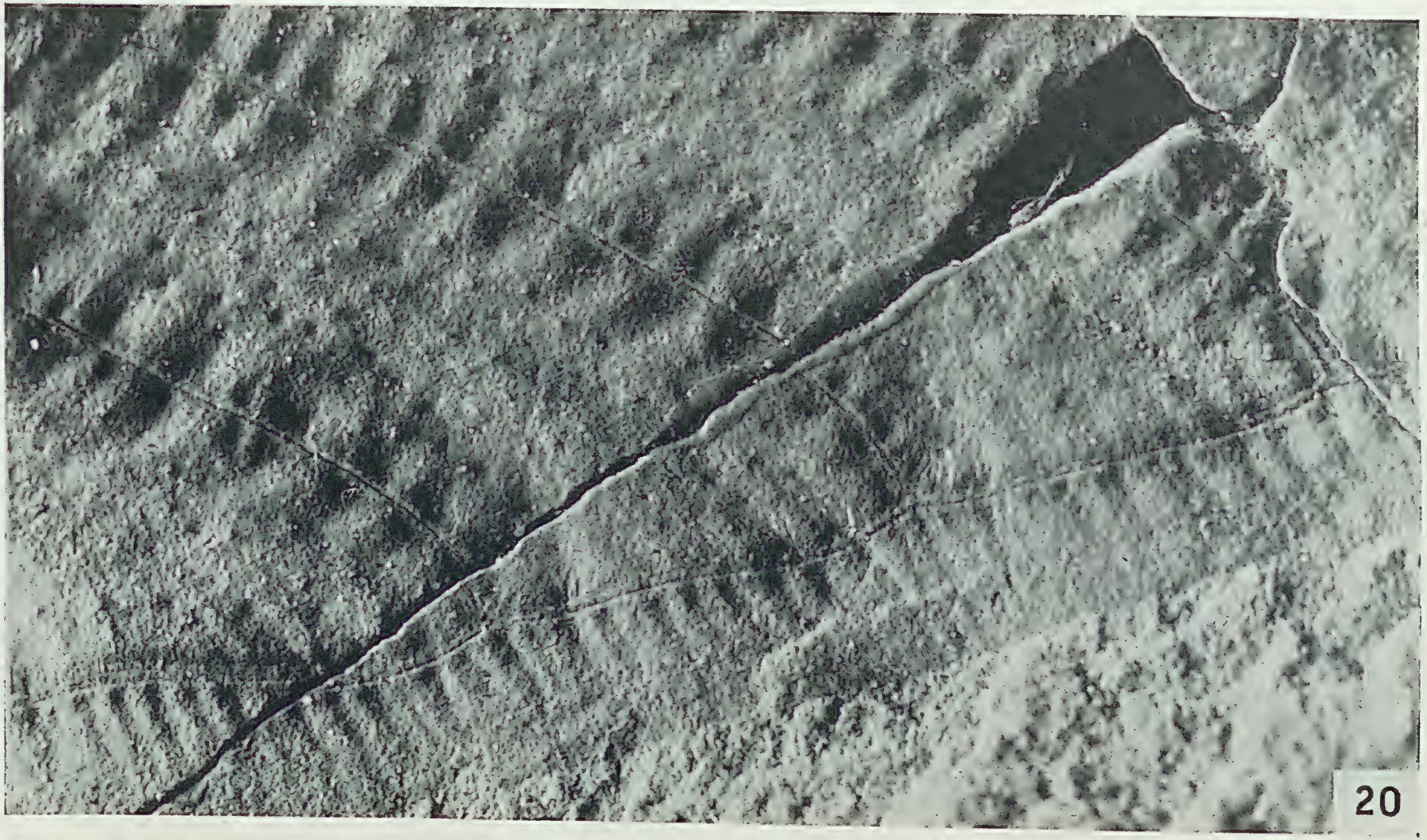
[Printed off 4th August, 1921.]

Mesogereon superbum, n.sp.

NATIONAL MUSEUM VICTORIA

Mesogereon superbum, n.sp.

NATIONAL MUSEUM

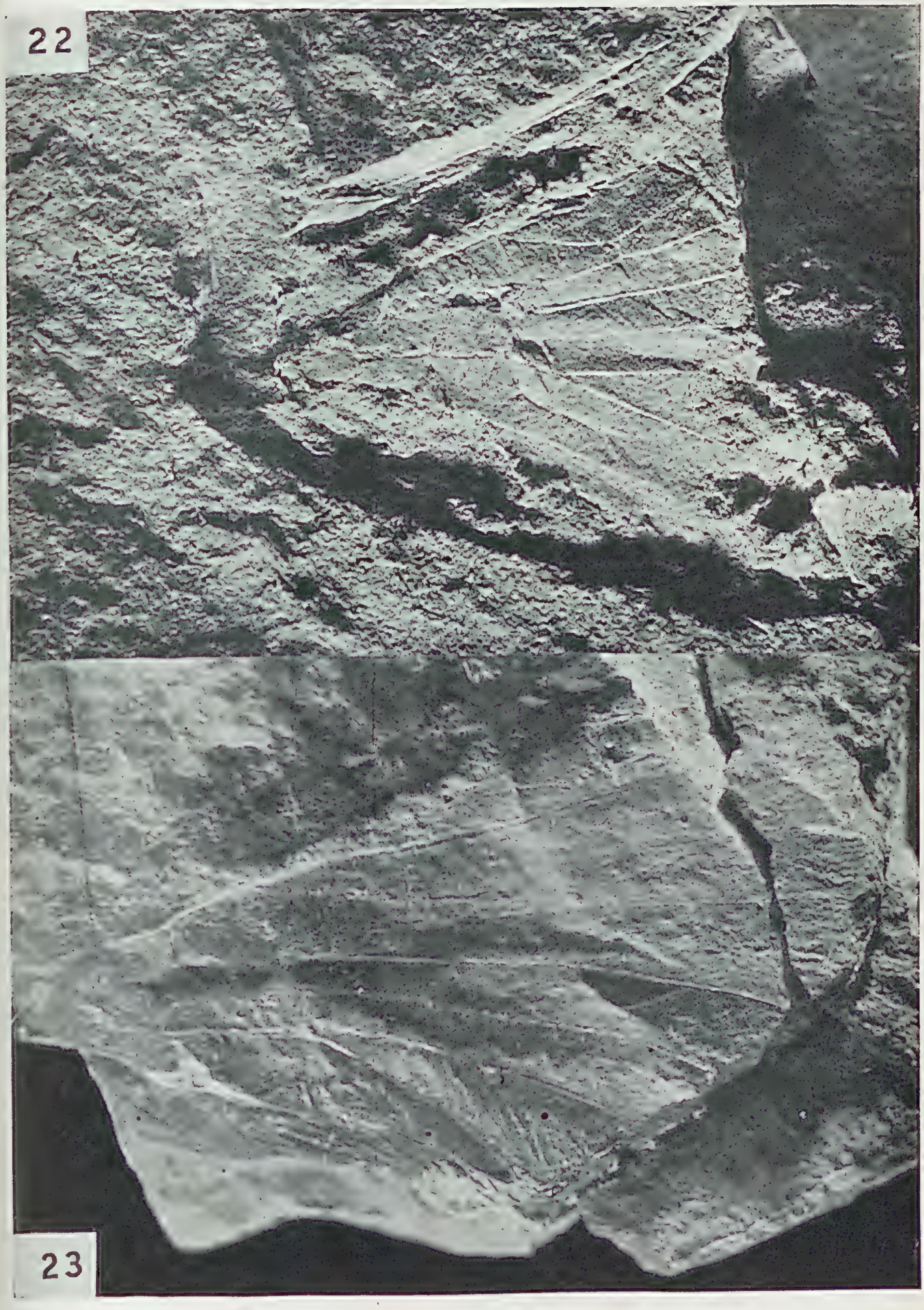


Mesogereon superbum, n.sp.

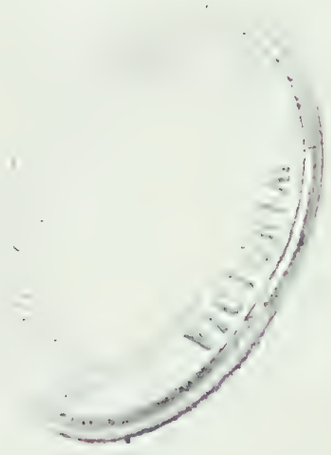
NATIONAL MUSEUM

Mesogereon affine, n.sp.

NATIONAL MUSEUM



22. *Mesogereon affine*, n.sp. 23. *M. shepherdi*, n.sp.



24. *Mesogereon neuropunctatum* Tillyard. 25. *M. shepherdi*, n.sp.

VICTORIA

From the Proceedings of the Linnean Society of New South Wales, xlvii., Part 4, 1922.

MESOZOIC INSECTS OF QUEENSLAND.

No. 9. Orthoptera, and Additions to the Protorthoptera, Odonata, Hemiptera and Planipennia.

By R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), C.M.Z.S., F.L.S., F.E.S., Entomologist and Chief of the Biological Department, Cawthron Institute, Nelson, N.Z.

(Plates li.-liii.; Text-figs. 72-89.)

[Read 25th October, 1922.]

The present paper completes the study of the Ipswich Upper Triassic fossils sent to me by Mr. B. Dunstan, Chief Government Geologist of Queensland, with the sole exception of the Coleoptera, which Mr. Dunstan himself is dealing with. In it no less than twenty species are dealt with, of which sixteen are described as new, while ten new genera are proposed for their reception. The species dealt with belong to the Orders Protorthoptera, Orthoptera, Odonata, Hemiptera (both Homoptera and Heteroptera) and Neuroptera Planipennia. A number of the fossils are shown enlarged on Plates li.-liii., which have been reproduced from photographs taken by Mr. W. C. Davies, Curator of the Cawthron Institute, to whom my best thanks are due. I also desire to thank Mr. F. Muir, the well known Homopterist of Honolulu, for valuable criticisms of my former publications on fossil Homoptera, as a result of which I have attempted some regrouping of the families represented in the Upper Trias.

Order **PROTORTHOPTERA.**

Family MESORTHOPTERIDAE.

Mesorthopteron locustoides, Tillyard, Mesozoic and Tertiary Insects of Queensland and N.S.W., Queensland Geol. Survey, Publ. No. 253, 1916, p. 14, Plate 2, figs. 3—6.

The types of this species are Specimens No. 5*a* and 5*b* in the Queensland Geol. Survey Collection at Brisbane. The fragment 5*c*, though originally figured (*l.c.*, Plate 1, fig. 4) as belonging to this species, can now be proved not to belong to it at all. The wing shown on Plate 1, fig. 5 of the same paper (Specimen No. 4), which was originally indicated as doubtfully belonging to this species, has now been shown, by further study and comparison with other fossils, to be the somewhat badly preserved tegmen of a Homopteron, *Mesocixiodes brachyclada,* n.sp., described in this paper.

Since the type was described, a number of fragments of this species have been discovered at Ipswich, together with one more complete specimen showing

a large portion of the wing. Taken together, they enable us to complete the restoration of the wing, the only parts not found upon one or other of the fragments being a portion of the distal area below the apex, together with the apical border itself, part of the distal branching of the cubitus, and the actual outline of the anal border. A study of all the specimens discovered shows that the original interpretation of the venation given by me was incorrect. A new definition of the family and genus is here given:—

Family *Mesorthopteridae*: Large Protorthopterous insects having rather long wings, well rounded at the apex, and carrying numerous main veins separated everywhere by a complete archedictyon or original meshwork of irregular polygonal cellules, as shown in Plate li., fig. 26. Costal space with many oblique veinlets. Sc a strongly formed vein. R strongly formed, with the origin of Rs placed far from base. M a weak vein fused with R basally and diverging only slightly from it. Cu_1 a very strongly formed vein, giving off a series of numerous anterior branches. Anal area rather narrow.

Genus MESORTHOPTERON Till. (Plate li., fig. 26; Text-fig. 72.)

Large insects having the forewing somewhat longer and narrower than the hind. Sc long, reaching to about one-fifth from apex, and with the subcostal veinlets evenly spaced and mostly unbranched. R_1 branching apically so as to fill the space between end of Sc and apex of wing. Rs with few branches, all running to margin around apex. M_{1+2} with few branches, M_{3+4} a weak furrow vein without any branches at all. Main stem of Cu_1 giving off anteriorly a series of about six anterior branches, very regularly arranged, most of which fork dichotomically before reaching the margin; the branches of this vein supply a space reaching from just below the apex right round to half-way along the posterior margin. Cu_2 a weak, straight, furrow vein, ending up somewhat before half-way along the posterior margin. Apparently only two anal veins, the first running parallel to Cu_2 just below it, and probably branched distally, the second somewhat curved, with a number of descending branchlets. In the costal and anal areas the archedictyon is much denser than on the rest of the wing, being formed of a very large number of very irregular cellules; in the rest of the wing, it consists chiefly of two rows of polygonal cells lying between each consecutive pair of longitudinal veins.

Genotype, *Mesorthopteron locustoides* Till.

The genus remains monotypic, and can be recognised at once by the extraordinary manner of branching of Cu_1, which, as far as I know, is unique within the Class Insecta. Small fragments of the wings of this insect are frequently met with at Ipswich, and can always be recognised by the very characteristic archedictyon.

MESORTHOPTERON LOCUSTOIDES Till. (Plate li., fig. 26; Text-fig. 72.)

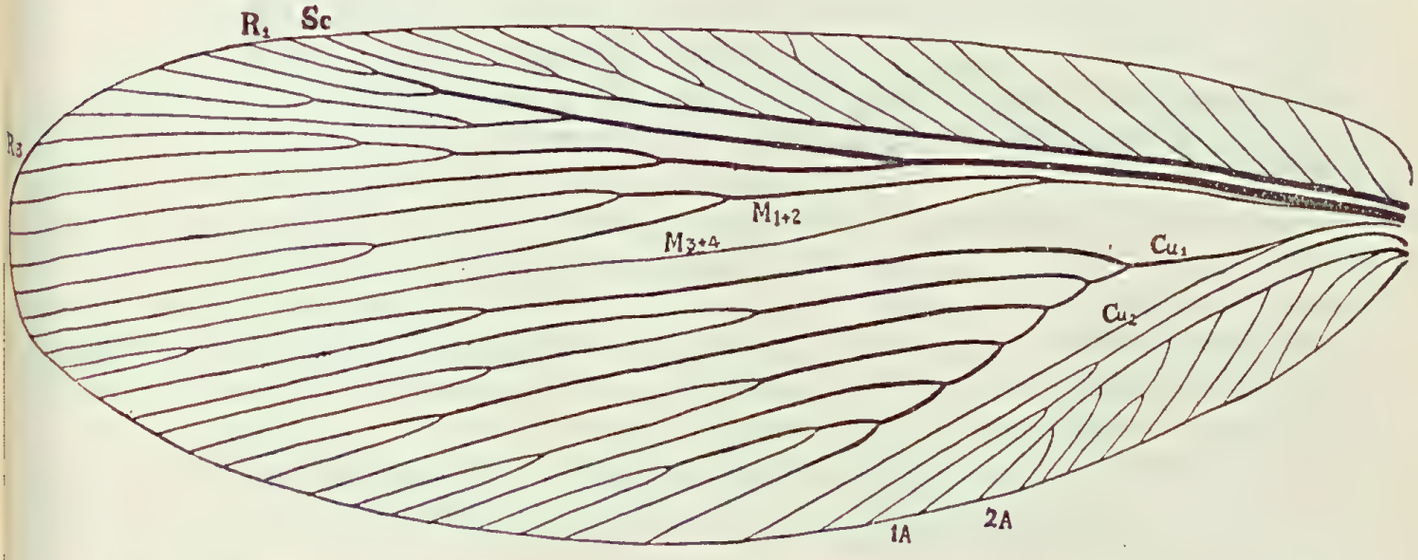
The restoration of this fine wing, given in Text-fig. 72, is based chiefly upon Specimen No. 258*b*, a large fragment of a forewing, showing almost the whole of the costal margin (except the apical and basal portions), and portions of all the veins down to within a short distance of the posterior margin; the latter, together with the anal area, is absent. *Total length* of fragment, 22.5 mm., from which the measurements of the complete forewing may be estimated to be about 35 mm. long by 15 mm. wide.

The other fragments studied in making the restoration were the following:—

Specimen No. 72 *a-b*: a small piece, showing portion of the anal veins and Cu_2.

Specimen No. 75: a fragment showing basal portions of Cu1, Cu2 and nearly all the anal veins.

Specimen No. 78*a-b*: portions of Cu1 and Cu2, showing branches of the former.



Text-fig. 72.—*Mesorthopteron locustoides* Till. Restoration of forewing, with archedictyon omitted (*see* Plate li., fig. 26.) (x 4).

Specimen No. 123: anal veins, basal part of Cu2 and portion of branches of Cu1.

Specimen No. 224: two fragments on one small piece of rock; one shows a piece of Sc with costal area, the other portions of the branches of Cu1.

Specimen No. 234: ends of Sc and R, with branches around apex.

Specimen No. 241*b*: Sc and the costal area practically complete from base to near apex, also distal portion of R.

Type, Specimens No. 5*a*, 5*b*, in Coll. Queensland Geol. Survey, Brisbane. Heautotypes used in restoring the wing are the specimens mentioned above.

This insect is clearly an archaic type persisting from the Upper Carboniferous Protorthoptera, and appears to have its nearest relatives in the Prototettigidae of the Middle Upper Carboniferous of Saarbrücken.

Specimens No. 100 and 162*a* are fragments of Protorthopterous wings not belonging to the genus *Mesorthopteron*, and distinguished from it by the fainter and more regular archedictyon and the very strong veins. They probably belong to the genus *Notoblattites* Till., but there is not enough of the wing preserved to allow of a definite placing and naming of the specimens.

Order **ORTHOPTERA.**

Family TRIASSOMANTIDAE, n.fam.

Insects of rather small size, in which the forewing is of the general plan shown in recent Mantidae, but with the venation of a more archaic type. Sc short, ending up little beyond half-way along the costa, and thus leaving a long pterostigmatic area between itself and R1. Rs arising nearer to base than in any known Mantoid types, and dividing dichotomically into two parallel branches. M a single vein to beyond middle of wing, dividing into two main branches beyond the level of the end of Sc. (Clavus and most of Cu missing).

This family appears to come fairly close to the Liassic Geinitziidae of Europe, but is more archaic in possessing a much longer Rs, which is dicho-

tomically forked. The small bark-haunting Perlamantinae, well represented in Australia to-day, are perhaps the direct descendants of this family.

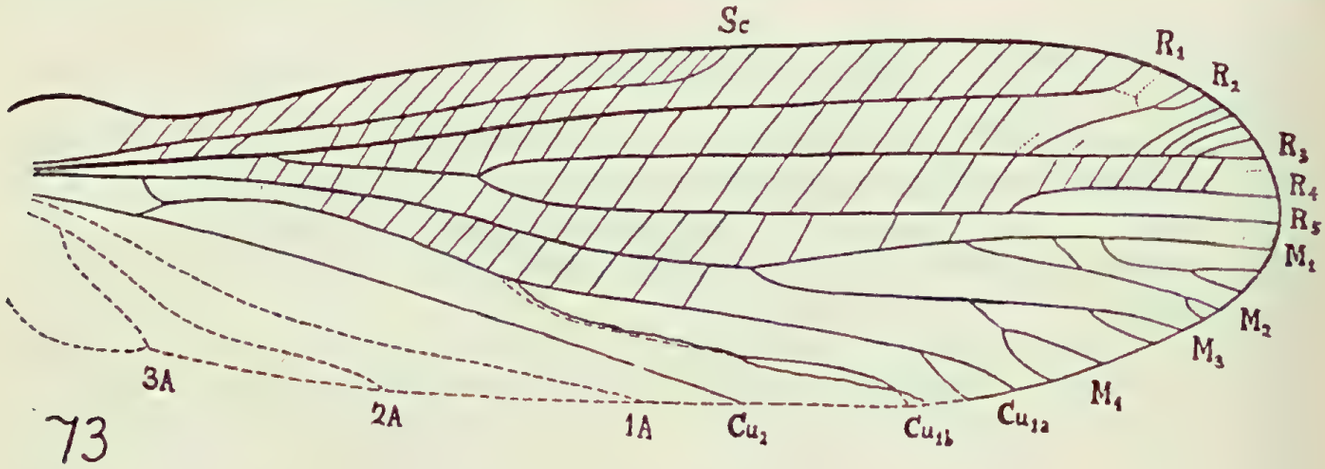
Genus Triassomantis, n.g. (Plate li., fig. 27; Text-fig. 73.)

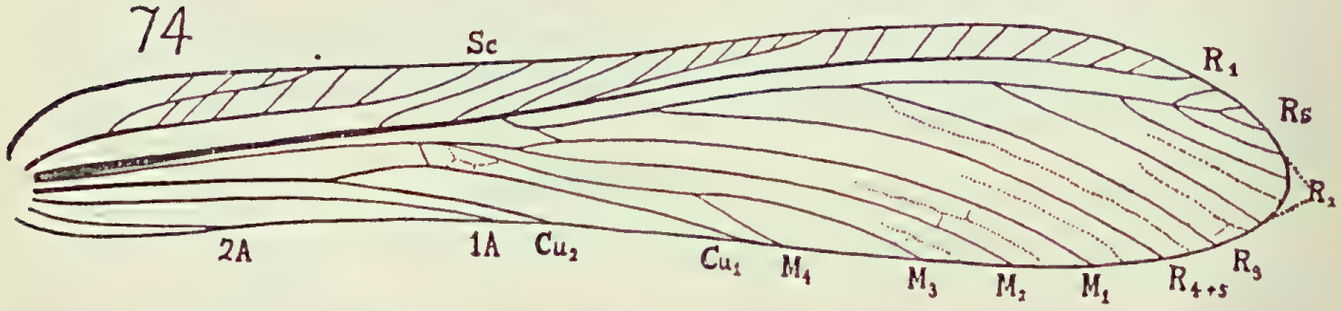
Characters as given for the family, with the following additions:—Costal and pterostigmatic veinlets, and all series of cross-veins, fairly abundant, oblique and parallel to one another. Sc and R_1 both turn fairly sharply upwards to end on the costal margin. R_{2+3} runs quite straight to a point a little above the apex, and gives off a strong anterior distal branch (R_2) below the end of R_1, together with a set of shorter distal branchlets anteriorly at the end of R_3. R_{4+5} also runs quite straight below and parallel to R_{2+3}, and gives off R_4 as a close parallel branch above R_5; the latter continues the line of R_{4+5} and ends up at the apex of the wing, which is well rounded. M slightly curved downwards near middle of wing; both its main branches give off somewhat irregular posterior branches with small terminal forks. Part of Cu_1 preserved distally as a straight vein having a small terminal fork.

Genotype, *Triassomantis pygmaeus*, n.sp. (Upper Triassic, Ipswich, Q.).

Triassomantis pygmaeus, n.sp. (Plate li., fig. 27; Text-fig. 73.)

This species is represented by a rather faint impression of a left forewing, complete except for the loss of the clavus and most of the cubitus. *Total length,*





Text-fig. 73.—*Triassomantis pygmaeus*, n.g. et sp. Restoration of forewing with apex to right (*see* Plate li., fig. 27.) (x 11).

Text-fig. 74.—*Triassolocusta leptoptera*, n.g. et sp. Restoration of forewing (*see* Plate li., fig. 28.) (x 5.4).

10 mm. *Greatest breadth,* 2.8 mm. The costal veinlets are numerous and more closely spaced than the cross-veins in the rest of the wing. The elongated pterostigma carries eleven veinlets spaced about the same distance apart as the cross-

veins in the radial and median areas below them. The number and position of the terminal branches of Rs and M may also be considered as specific characters; R_3 has four closely placed anterior branchlets, while M_{1+2} and M_{3+4} both run straight to the wing margin, giving off only posterior branches as shown in Text-fig. 73. M_{1+2} converges towards R_5 from below.

Type, Specimen No. 86*a*, in Coll. Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

The size of this wing appears to indicate a small insect, not unlike the present day Perlamantinae, and possibly of somewhat similar habits. The restoration of the missing parts of the wing, in Text-fig. 73, is made on the supposition that the missing portion of the venation was on the Perlamantine plan.

Family LOCUSTOPSIDAE.

This family was formed by Handlirsch to include a number of Liassic and Upper Jurassic Locustoid insects allied to the Elcanidae, but differing from them in having M branched instead of simple, Sc much longer, and Cu not fused basally with M. The fossil from the Upper Trias of Ipswich, which I here place under this family, agrees with the Locustopsidae in all characters except only the short Sc, a character which I do not consider of sufficient importance to justify the making of a new family to contain it. The definition of the family Locustopsidae will therefore need emending as regards the length of Sc, which may be either short or long. These insects appear to have been slender, voiceless Locustoids, having very long and slender antennae, and with the long, slender hind-legs not armed with spines.

Genus TRIASSOLOCUSTA, n.g. (Plate li., fig. 28; Text-fig. 74.)

Insects of moderate size, with forewing very long and narrow. Sc ending up before half-way along costal margin, and provided with a shorter anterior branch. Rs arising somewhat before half-way along the wing, with four distinct and well-spaced branches arranged in pectinate series. M branching into three near level of origin of Rs; the most posterior of these three branches, M_{3+4}, forks again distally. First fork of Cu placed well away from base, at about one-fourth of the wing-length. Cu_1 arching somewhat flatly upwards, connected with M above by an oblique vein (M_5), and forked distally. Cu_2 short, straight, ending up very close to Cu_{1b}. (Clavus missing).

Genotype, *Triassolocusta leptoptera*, n.sp. (Upper Triassic, Ipswich).

TRIASSOLOCUSTA LEPTOPTERA, n.sp. (Plate li., fig. 28; Text-fig. 74.)

Total length, 21 mm., *greatest breadth* (at about one-fifth from apex), 4 mm. The specimen is a very clear impression of a right forewing, complete except for the loss of the very narrow clavus and slight damage to the basal portion of the costal margin. Veinlets and cross-veins are only faintly preserved, and are mostly omitted from Text-fig. 74. Sc gives off an anterior branch Sc_1, quite close to the base; this branch has about four faint oblique cross-veins below it, and is separated from the end of the main stem of Sc by two oblique veinlets. From a little before the level of the end of Sc, R begins to give off anterior veinlets running very obliquely to the costal margin. There are three of these, the last being at the level of the origin of Rs. Next comes a fairly long anterior branch, running at a very slight angle to R_1 itself, and carrying on it four or five shorter anterior veinlets. Beyond this branch lies a series of pterostigmatic veinlets, eight in number, less obliquely placed. R_1 itself ends

up not much before the apex of the wing. Rs has, besides the series of four pectinate branches already mentioned in the generic definition, a set of four terminal twigs arranged as shown in Text-fig. 74; the branch next below these ends exactly at the apex of the wing. The cross-venation in the spaces between the branches of Rs and M distally is a fine polygonal meshwork, two cells thick within each successive space, the borders of the cells making a slightly irregular line, dividing each space longitudinally about midway. Portions of these are indicated by dotted lines in Text-fig. 74.

Type, Specimen No. 99, in Coll. Queensland Geol. Survey.

Horizon, Upper Triassic, Ipswich, Q.

In Text-fig. 74, the clavus has been restored on the lines shown in the genus *Locustopsis* Handl., with only two anal veins.

Order **ODONATA.**

Suborder **Archizygoptera.**

Family MESOPHLEBIIDAE.

Further study of the genus *Mesophlebia* (Tillyard, 1916, p. 24) has convinced me that it does not belong to the Anisoptera, but to Handlirsch's Suborder Anisozygoptera, to which also most of the known Liassic Dragonflies belong. It seems best to treat it for the present as representative of a new family Mesophlebiidae, which shows some affinity with the Liassic Heterophlebiidae. The exact relationships of the new family cannot be accurately determined until the basal half of the wing is discovered.

MESOPHLEBIA ANTINODALIS Till. (Plate lii., fig. 30; Text-fig. 75.)

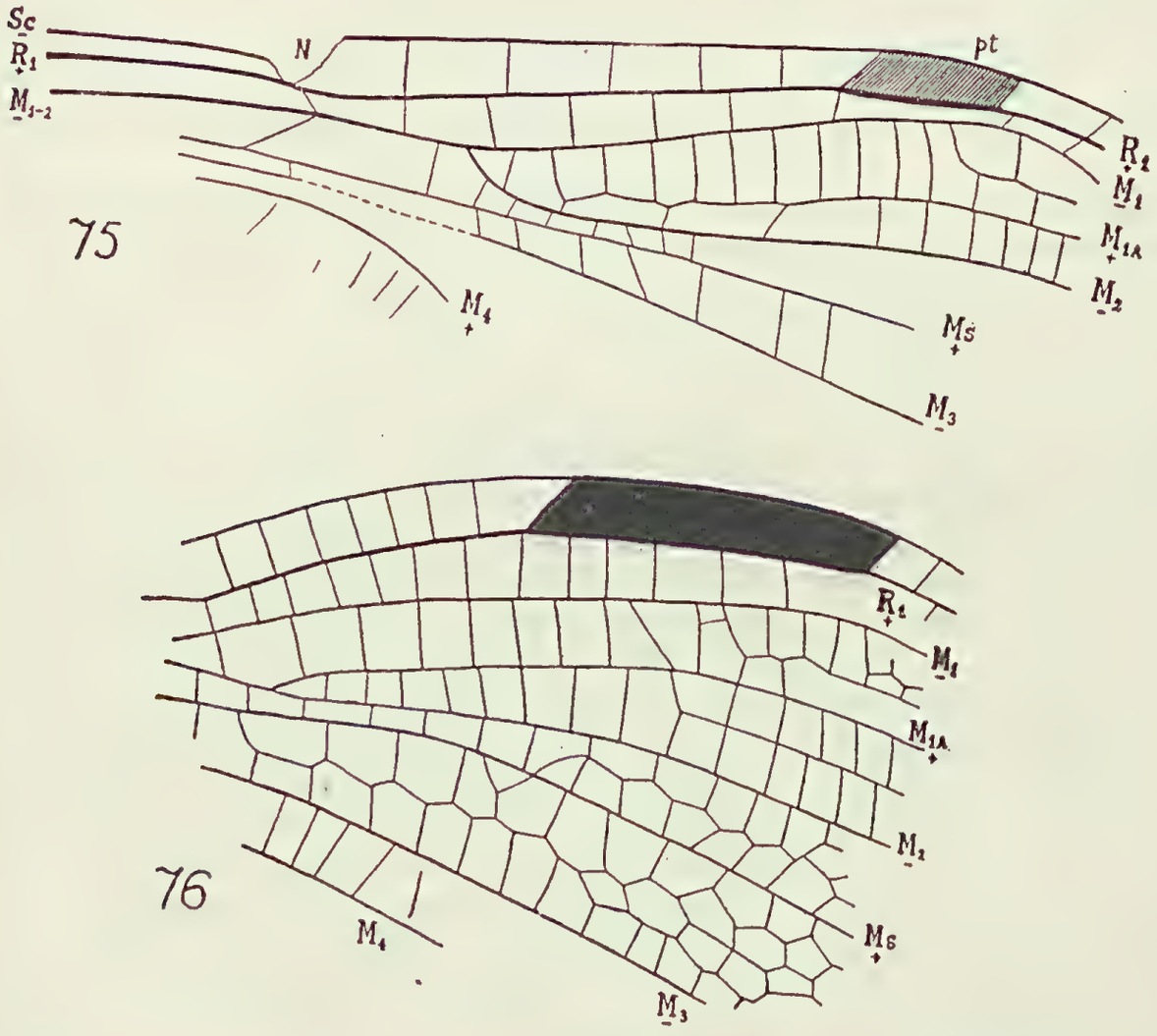
Tillyard, Mesozoic and Tertiary Insects of Queensland and New South Wales, Qld. Geol. Survey, Publ. No. 253, 1916, p. 24.

Specimen 127*a* represents a fairly well preserved portion of a right forewing of this species, comprising the whole of the costal margin from somewhat before the nodus to a little beyond the pterostigma, and including the subnodus and all branches of M except M_4, of which only a very small portion is preserved. The nodus is incomplete basally by the loss of the costal margin, though Sc is complete. The pterostigma is complete and remarkably well preserved.

Total length of fragment, 28 mm. *Distance from nodus to beginning of pterostigma,* 12 mm. *Length of pterostigma,* 3.6 mm. The approximate total length of the wing must have been about 40 mm. By comparison with the type specimen, the present wing is found to be somewhat narrower in comparison with its length, and may therefore be considered as a forewing, the type specimen representing a hindwing. The pterostigma, however, is longer than in the type (3.6 mm. as against 2.8 mm.) which is a somewhat anomalous condition. *Number of postnodals* five, as in type. *Pterostigma* slightly wider basally than distally, slightly shorter along costa than along R, and strongly thickened along R. No brace-vein below pterostigma. A strong, oblique subnodus between R and M_{1+2}, strutted below, between M_{1+2} and Ms, by a much longer oblique cross-vein running in the opposite direction, at right angles to subnodus. M_1 curving upwards so as to come to lie close under pterostigma, as in the type. Structure of M_{1A} and M_2 very closely similar to type, but the broadened space between M_1 and M_{1A} below distal half of pterostigma carried definitely two rows of cellules. A weak oblique vein indicated between M_2 and Ms, far from level of nodus, and a similar but longer oblique vein below it, between Ms and M_3.

Distad from level of nodus, M_4 arches rather sharply downwards away from M_3, as also in type.

The differences to be noted between the new specimen and the type consist in the presence of a definite subnodus normally placed, the absence of the weak pterostigmatic brace-vein shown in the type, the longer pterostigma, and the double row of cellules distally below the pterostigma. As the type was not very well preserved in places, it is possible that these differences may not really have been as great as they appear, e.g., the apparent brace-vein in the type may be only very slightly different from the normal cross-vein of the present specimen,



Text-fig. 75.—*Mesophlebia antinodalis* Till. Heautotype. (*see* Plate lii., fig. 30.) (x 3.5). Convex veins marked +, concave veins —.

Text-fig. 76.—*Triassophlebia stigmatica*, n.g. et sp. Fragment of wing. (x 5). Convex veins marked +, concave veins —.

while the subnodus may be present in the type, but indistinct, and the same may be true of the double row of cellules below the pterostigma. I have therefore decided not to give the new fossil a separate specific name, but to include it in the species *M. antinodalis* Till., allowing a certain amount of variability in the length of the pterostigma in this species, and in one or two other characters. It is a great pity that this second fossil shows practically the same portions of the wing preserved as in the type, while the important region of arculus and discoidal cell still remains undiscovered.

Type, Specimen No. 3*a*, and Type-Counterpart Spec. No. 3*b*. Heautotype, Specimen No. 127*a*. All in Coll. Queensland Geol. Survey, Brisbane.

Genus TRIASSOPHLEBIA, n.g. (Text-fig. 76.)

Pterostigma elongated, about twice as long as in *Mesophlebia*. *Postnodals* numerous and close together. M_1 only slightly converging towards R beneath distal end of pterostigma. M_{1A} and M_2 very much as in *Mesophlebia*, but M_{1A} definitely arising from M_2. Supplementary sectors present distally between M_1 and M_{1A}, also between M_{1A} and M_2. Ms running very close below M_2 at level of origin of M_{1A}, as in *Mesophlebia*, but no oblique vein visible between M_2 and Ms. Two rows of cellules present distally between M_2 and Ms. M_3 lies further away from Ms than in *Mesophlebia*, with two rows of cellules between them at the level of the origin of M_{1A}, increasing to three and then to four rows distally. M_4 not arching strongly downwards away from M_3. (Rest of wing not preserved).

Genotype, *Triassophlebia stigmatica*, n.sp. (Upper Triassic, Ipswich, Q.).

This new genus may be placed provisionally within the Mesophlebiidae, pending the discovery of more complete material.

TRIASSOPHLEBIA STIGMATICA, n.sp. (Text-fig. 76.)

Total length of fragment, about 14 mm., probably representing a total wing-length of at least 40 mm. *Number of postnodals* preserved or partially preserved, eight, indicating a total of about twelve. *Pterostigma* covering about nine or ten cellules. R somewhat thickened below pterostigma, but not so strongly as in *Mesophlebia antinodalis*. M_{1A} arises from M_2 as a well defined vein, strongly convex, well before the level of the pterostigma, and continues strongly to below the middle of the latter, when it becomes slightly kinked in one or two places, as shown in Text-fig. 76. Supplementary sector above M_{1A} preceded by three irregularly divided cellules; that below M_{1A} is a straight sector from its very beginning, preceded by a single row of cellules. M_2 arising from M as a strongly diverging vein which almost at once approaches Ms very closely, being separated from it only by a single row of very narrow cellules; further distad, below the level of the pterostigma, these two veins diverge somewhat, and are separated by two rows of cellules. The portion of M_3 preserved runs subparallel to Ms, and is separated from it mostly by two rows of cellules, increasing to three or four rows of smaller cellules distally. Only a small portion of M_4 is preserved, diverging slightly from M_3, and separated from it by a single row of cellules.

Type, Specimen No. 82*a* in Coll. Queensland Geological Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Suborder **Anisozygoptera.**

Family TRIASSAGRIONIDAE, n.fam.

Sc greatly shortened, ending up at less than one-fourth of the wing-length. Probably only two antenodals present. No definite nodus formed. Postnodals numerous. A true pterostigma present. Base of wing petiolate, very narrow. M fused with R basally, diverging very gently from it at the arculus, which is incomplete posteriorly. No true discoidal cell present. At the arculus M divides into M_{1-3} and M_4; the former is a strong concave vein, running below and sub-parallel to R_1, and giving off (*a*) the common stem of M_3 and Ms, and (*b*) at about twice as far from the arculus, the stem of M_2. M_2 arises from M_1 a little before half-way along the wing, arching strongly downwards, and

soon dividing into two strong branches, which diverge at a sharp angle; the upper branch, M_{2a}, runs straight along the wing to end up just below the apex, close to M_{1A}, which is a long sector formed between M_1 and M_2; the lower branch, M_{2b}, runs obliquely just above Ms. The common stem of Ms and M_3 soon divides at a very acute angle into Ms, which runs straight on, obliquely across the wing, and M_3, which arches so as to end up about half-way along the posterior border, far from Ms, but very close to M_4. M_4 is a slightly arched, unbranched, convex vein, rather weakly formed distally. The cubitus is a simple, concave vein, corresponding with Cu_1 of recent Odonata, slightly curved below the arculus, and then running almost straight on to end up at about the middle of the posterior border, a little before M_4. Anal crossing present as a weak cubito-anal veinlet, situated at the end of the petiole, and marking the origin of 1A from Cu; 1A itself runs between Cu and the posterior border, and ends up not far from Cu. Both Cu and 1A become weak and somewhat zig-zagged distally.

Handlirsch formed the new Suborder Archizygoptera to include the single peculiar and highly problematical genus *Protomyrmeleon* Geinitz, represented by a single species, *P. brunonis* Geinitz, from the Upper Lias of Dobbertin in Mecklenburg. This fossil was placed by him in the family Protomyrmeleontidae, the only family of the Suborder. The present fossil agrees with *Protomyrmeleon* in the very striking characters of the shortened Sc, unformed nodus, peculiar development of M_{1A}, two-branched M_2 and simple cubitus, but appears to differ in the base not being petiolate, M arising separate from R, so that no arculus is formed, separation of the base of Ms from M_3, and entire absence of 1A. (It should be noted that Handlirsch's naming of all the veins after M_1 is incorrect, his M_2 being actually M_{1A}; his Rs, M_{2a}; his M_3, M_{2b}; his M_4, Ms; and his Cu_1, Cu_2 and 1A being M_3, M_4 and Cu respectively). It would appear highly probable that the true base of *Protomyrmeleon* has not been preserved, including the petiole (if present), the portion of M fused with R, and the true arculus. This misled Handlirsch in naming the veins. As drawn by him in Plate xlii., fig. 14 of his Atlas to "Die Fossilen Insekten," there is, in any case, no true 1A in this genus.

Genus TRIASSAGRION, n.g. (Plate lii., fig. 31; Text-fig. 77.)

To the characters given for the family we may add the following for the genus:—*Postnodals* about twenty-four, the basal ones mostly continuous with the cross-veins below them, the distal ones not so. *Pterostigma* short, about twice as long as wide. R_1, M_1, M_{1A} and M_{2a} all ending up close together at or near apex of wing. M_{1A} arises as a weak zig-zag vein from near base of M_2, and runs very close above M_2 at first, but gradually diverges until, below the pterostigma, it runs as a straight vein about half-way between M_1 and M_{2a}. The wide triangular spaces between the two branches of M_2 and also between Ms and M_3 are filled with irregular cellules, without any supplements. Only one row of cellules between 1A and the posterior border of the wing.

Genotype, *Triassagrion australiense*, n.sp. (Upper Triassic, Ipswich, Q.).

It is useless to try to compare this genus closely with any existing Zygoptera, owing to the great difference in the structure of the arculus, the entire absence of the discoidal cell, the primitive condition of Cu and 1A, and the branched condition of M_2. I would, however, call attention to certain resemblances which it bears to the forewing of the genus *Chorismagrion* Morton. This latter genus, found in North Queensland at the present day, has the arculus open basally in

the forewing; Sc is very short; M_{1-3} gives off the common stem of M_3 and Ms at the subnodus, and M_2 far beyond it, with M_{1A} forming a well developed vein between M_1 and M_2; Cu, except for current usage, might well be interpreted as a simple vein, 1A arising separately out of the posterior margin just beyond the end of the petiole, and connected with Cu above it by the anal crossing. Again, if we look at the genus *Hemiphlebia,* which also has the arculus incomplete basally in the forewing, we see that the same interpretation of Cu and 1A is the obvious one, and that 1A actually arises from the cubito-anal veinlet as it does in *Triassagrion,* with a small cross-vein connecting it with the end of the petiole as in that genus. This latter character, being unique in present-day Zygoptera, is a very significant one. I therefore suggest the *probability* of our modern Zygoptera having arisen from some such form as *Triassagrion* by the following changes:—

(1) Formation of a complete nodus by strengthening of the subnodal cross-veins between end of Sc and R, and between R and M_{1-3}.

(2) Formation of the strong distal side of the still open discoidal cell, by change of direction of the first cross-vein between M_4 and Cu.

(3) A further bending of Cu below arculus, correlated with (2).

(4) Cross-vein situated below distal angle of discoidal cell becomes strong and oblique, and, in the nymphal wing, carries a trachea which captures 1A and attaches it to Cu.

(5) Shortening and simplification of M_{1A}.

(6) Reduction of M_2 to a simple vein.

(7) Approximation of M_3 towards Ms.

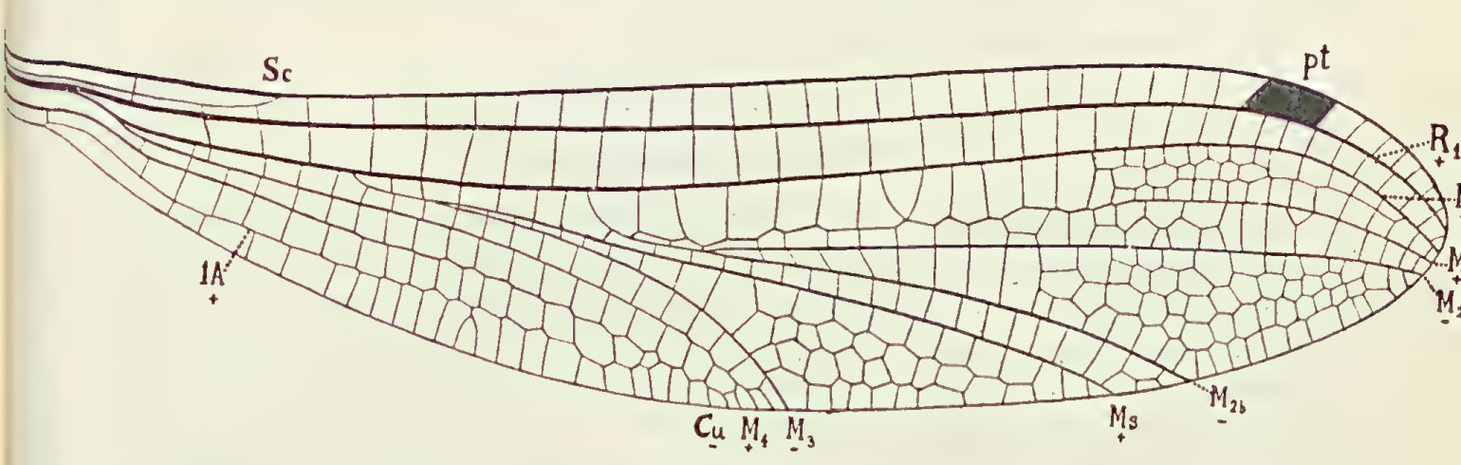
Definite proof of the origin of modern Zygoptera from such a type as *Triassagrion* cannot be given with the present state of our knowledge. It is more probable that a considerable number of archaic types ancestral to various groups of the true Zygoptera were already in existence in the Upper Trias. One, indeed, we already know in the genus *Triassolestes,* related to *Epiophlebia.* We can only add that the recent studies of Professor C. H. Kennedy on the penes of Zygoptera strongly indicate the probability of forms such as *Hemiphlebia* and the Megapodagrionidae being the oldest existing Zygoptera, and that this result, startling as it appears to be, would be quite in harmony with the evidence of our Upper Triassic fossils.

TRIASSAGRION AUSTRALIENSE, n.sp. (Plate lii., fig. 31; Text-fig. 77.)

An almost complete wing, probably a forewing. *Total length,* 21 mm; *Greatest breadth,* 4.5 mm. The wing is the reverse of a left wing, as is shown by R_1 being concave and M_1 convex in the impression.

The wing is complete except for the following missing parts:—Portions of the costal area broken away (*a*) before the end of Sc, (*b*) in two places between Sc and pterostigma, the second of these being a deep triangular break reaching across R_1, as shown in Plate lii., fig. 31, and (*c*) from pterostigma to near apex; in this last case, the two posterior angles of the pterostigma are visible, and also the whole of the straight and slightly thickened base along R_1, so that the stigma itself can easily be restored in its entirety. The basal piece of Cu up to beginning of arculus is very faintly preserved, and has been restored backwards to base, in Text-fig. 77, along the line faintly indicated in the fossil. The posterior margin of the petiole is absent, but a clear indication of the cubito-anal crossing and the beginning of 1A below it can be seen; most of the course of 1A is very faint indeed. Between the origins of M_3 and M_2, the wing has become slightly buckled by lying above a hard, convex object, probably a fruit

or cone of some plant, and this has also caused the transverse tear, which can be seen across veins M_4 and Cu_1 in Plate lii., fig. 31, somewhat anterior to this point, and is indicated by the dark shadow. The distal halves of M_4 and Cu_1 are thus shifted upwards out of their proper levels, and at the same time



Text-fig. 77.—*Triassagrion australiense*, n.g. et sp.. Restoration of wing. (*see* Plate lii., fig. 31.) (x 6.3). Convex veins marked +, concave veins —.

it is probable that, by slight longitudinal rucking, the veins M_3, Ms and M_2 have got pushed together more closely, near their origins, than would be the case if the wing were lying flat. The correct positions of these last three veins cannot be exactly restored; but, in the case of M_4 and Cu, the former being convex and the latter concave, it is easy to pick up their broken courses, and to restore them as in Text-fig. 77.

Plate lii., fig. 31 shows this fossil wing with the light so arranged that the main veins are well shown up; consequently, the cross-veins are not well shown, being mostly at right angles to the main veins. Under a moderate power, however, every single cross-vein of this wing can be seen, though they are all of very fine calibre. The only parts which cannot be restored with absolute certainty are those where there has been a break or rucking. In this connection, I desire to emphasize the following points:—

(1) In the restoration, the origins and basal portions of M_3, Ms and M_2 are probably crowded a little too closely together, owing to the rucking already mentioned.

(2) It is not absolutely certain that there are only two antenodals; there may be another one closer to the distal end of Sc.

(3) Cu, being a concave vein, is raised up in this reverse impression, and its basal piece, within the petiole, has the actual impression of the vein removed, as often along a ridge; its course, however, seems fairly well indicated, and it is restored in its normal position for Zygoptera.

(4) The posterior border of the petiole is also missing. But the anal crossing, Ac, can be seen, with faint indications of the origin of 1A below it. The restoration is given in the only possible way in which these remnants can be made to fit into the wing-scheme, but must not be taken as being absolutely accurate.

(5) The breaks along the costa have been filled in by completing the series of postnodals, and by continuing the oblique sides of the pterostigma upwards from the preserved posterior portion along R_1. As this vein can be seen to be strongly thickened below the pterostigma, the assumption that the latter was well chitinised is, I think, justified.

The importance of this wing in the study of Odonate phylogeny seems to me to be so great that it is essential that all doubtful points in the restoration of the wing should be fully emphasized.

Type, Specimen·290*a* (reverse), in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Order **HEMIPTERA.**

Suborder **Homoptera.**

Since the publication of Nos. 7 and 8 of this series of papers, a considerable number of tegmina have been sent to me from the Ipswich fossil beds. It is now apparent that, next to the Coleoptera, the Homoptera were the dominant Order in the Upper Trias of Ipswich. We now know enough to attempt a review of the whole position of the Suborder at that period; the difficulty is not so much lack of knowledge of the Triassic forms, as the still fluctuating and uncertain schemes of classification of recent Auchenorrhyncha, particularly in the Superfamily Fulgoroidea. Mr. F. Muir, the well-known authority on these insects, has recently taken considerable interest in the fossil discoveries at Belmont and Ipswich; and he writes to me that, in his opinion, the Suborder Palaeohemiptera of Handlirsch does not exist, as the two genera still included in it (*Prosbole* Handl. and *Mitchelloneura* Till.) may reasonably be considered as archaic Fulgoroids of the family Tropiduchidae, the connection being furnished by the evidence of the venation of the South American genus *Alcestis*. Accepting this view, it becomes evident at once that the tegmina placed in this paper under the genus *Mesodiphthera* are even more typically Tropiduchid than those already mentioned. I therefore have no hesitation in removing them from the Scytinopteridae and placing them in the Tropiduchidae. Mr. Muir is also of opinion that the forms placed by me in the subfamily Mesocixiinae of the Scytinopteridae are true Cixiidae, a conclusion which seems reasonable when we consider that this family stands morphologically at the very root of the Fulgoroidea. I shall therefore remove the genera *Mesocixius* Till., *Triassocixius* Till. and *Mesocixiodes*, n.g. to the family Cixiidae. The Ipsviciidae may also be considered to be a specialised family of Fulgoroidea, and are almost the only Triassic forms in which the evolution of the anal Y-vein on the clavus can be seen to have begun.

This leaves in the Scytinopteridae the Upper Triassic genera *Mesoscytina* Till., *Triassoscarta* Till. and *Chiliocycla* Till. To these will be here added the two new genera *Apheloscyta* and *Polycytella*, the former allied to *Scytinoptera* Handl. and the latter to *Chiliocycla*. It is possible that the two genera *Chiliocycla* and *Polycytella* may prove to be Membracids of a primitive type; but until we can discover the clavus of *Chiliocycla*, so as to determine the course of 1A, it will be best to leave them in the Scytinopteridae.

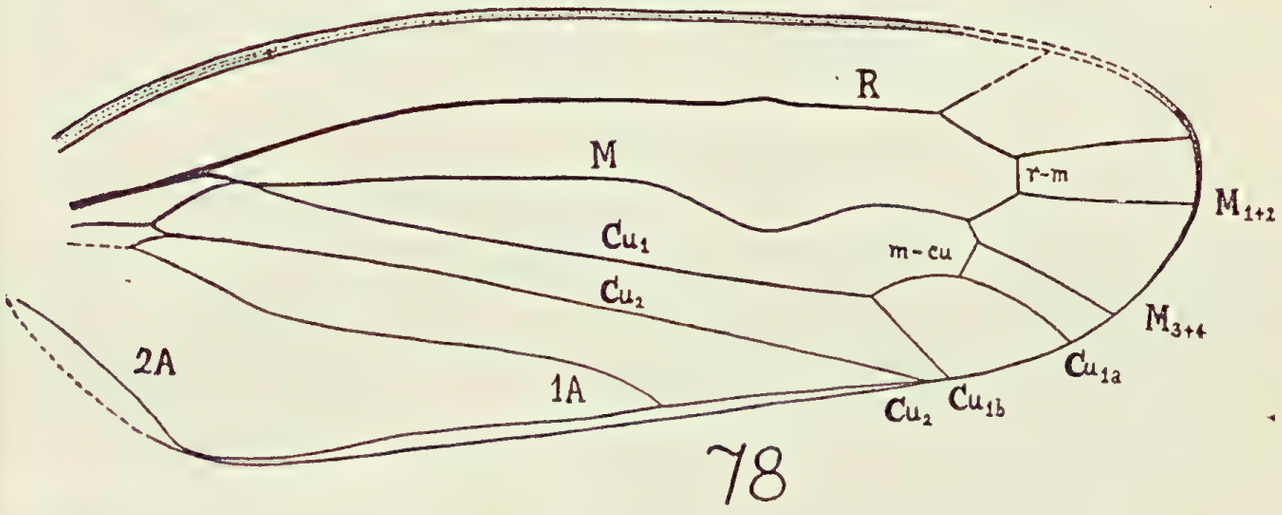
The other families of Auchenorrhyncha represented in the Upper Triassic of Ipswich are the Mesogereonidae, ancestral to the Cicadidae, and the Cicadellidae or Jassidae. No further examples of these are dealt with in this paper.

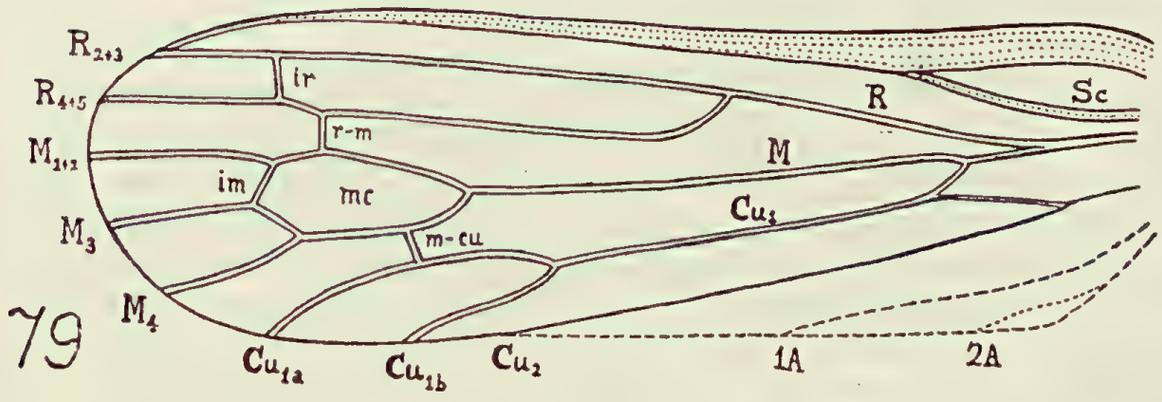
Family SCYTINOPTERIDAE.

Genus APHELOSCYTA, n.g. (Plate liii., fig. 33; Text-fig. 78.)

Allied to *Scytinoptera* Handl. from the Upper Permian of Russia, but differing from it in having Rs coming off from R quite close to the apex of the wing, whereas Rs arises about half-way along R in *Scytinoptera*. Vein M, which

is quite straight in *Scytinoptera,* is bent sharply into a very noticeable bay or hollow, concave to the costal margin, a little beyond the middle of the wing, in the new genus. Terminal branchings of M and Cu1 two each, connected by a single cross-vein much as in *Scytinoptera,* but M_{3+4} and Cu_{1a} lie closer together. Clavus (missing in *Scytinoptera*) of fairly typical Scytinopterid type, but 2A





Text-fig. 78.—*Apheloscyta mesocampta*, n.g. et sp. Tegmen. (*see* Plate liii., fig. 33.) (x 10.3).

Text-fig. 79.—*Chiliocycla scolopoides* Till. Restoration of tegmen from type and heautotype, with tuberculation omitted. (x 11.7). (*see* Plate liii., fig. 37.)

lies very close to the basal posterior margin, and appears also to run close alongside the distal posterior margin of the clavus, thus showing a very early stage in the evolution of the true claval Y-vein found in the Fulgoroidea. Shape of wing somewhat different from that of *Scytinoptera,* the costal area being about equally wide throughout, and the apex much less broadly rounded.

Genotype, *Apheloscyta mesocampta,* n.sp. (Upper Triassic, Ipswich).

APHELOSCYTA MESOCAMPTA, n.sp. (Plate liii., fig. 33; Text-fig. 78.)

Total length, 10 mm.; *greatest breadth,* 3.5 mm.

A complete tegmen, except for slight damage at the base of the clavus and also at end of R_1; of tough consistency, strongly granulated all over. All the main veins clearly marked, but the distal branchings somewhat fainter. The im-

pression is that of a left tegmen, of which both obverse and reverse are preserved; the latter is the better impression of the two.

Type, Specimen No. 98*a* (reverse) in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Genus CHILIOCYCLA Till.

Tillyard, Proc. Linn. Soc. N.S.W., xliv., pt. 4, 1919 (1920), p. 868.
Genotype, *Chiliocycla scolopoides* Till. (*l.c.*, p. 869).

CHILIOCYCLA SCOLOPOIDES Till. (Plate liii., fig. 37; Text-fig. 79.)

Specimen No. 327*a* is a second example of this interesting tegmen, more complete basally than the type, but with the clavus missing, and the sculpture much more poorly preserved. Combining the two tegmina, it is possible to offer a reconstruction of the tegmen as shown in Text-fig. 79, the very strong sculpture of flat circular tubercles, covering all except the distal end of the tegmen, being omitted. The new specimen shows very clearly the excessively strongly built costal border basally, and the short Sc connecting with it. The restoration of the clavus is purely provisional.

Types: Holotype, Specimen No. 158*a*; heautotype, Spec. No. 327*a*, in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Genus POLYCYTELLA, n.g. (Plate liii., fig. 36.)

Tegmen of rather long, narrow shape, strongly sculptured all over with a meshwork of raised polygonal cellules, somewhat resembling the flattened tubercles of *Chiliocycla*, but placed more closely together. Only four main veins between the costa and the vena dividens, viz., Sc, R, M and Cu_1. These radiate out from near the base of the wing, and run almost straight to the wing-margin, without any branches. Sc very short; R ends up about half-way along the curved costal margin, M near apex, and Cu_1 well below apex. Cu_2 (vena dividens) runs straight to a little beyond half-way along posterior margin of wing. Clavus (partially missing) apparently rather narrow, the courses of the anal veins not preserved.

Genotype, *Polycytella triassica*, n.sp. (Upper Triassic, Ipswich).

POLYCYTELLA TRIASSICA, n.sp. (Plate liii., fig. 36.)

Total length of fragment, 7.5 mm., representing a tegmen of about 8.5 mm. in length. The costal margin is not very well preserved, except at the extreme base, where there may also be seen a short, slender vein, probably a much shortened Sc, separated from the costa by a single row of cellules. Between Sc and R there are three rows of cellules, somewhat irregularly arranged. The number of rows of cellules between R, M, Cu_1 and Cu_2, respectively, increases in each case from the base outwards from one or two up to six or seven rows, and the individual cellules become somewhat larger distally. The distal two-fifths of the costa and the whole of the apical margin to a little below the end of Cu_1 are missing, as is also most of the clavus.

Type, Specimen No. 81*a*, and paratype No. 154 (poorly preserved), in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Family TROPIDUCHIDAE.

Genus MESODIPHTHERA Till. (Text-figs. 80, 81.)

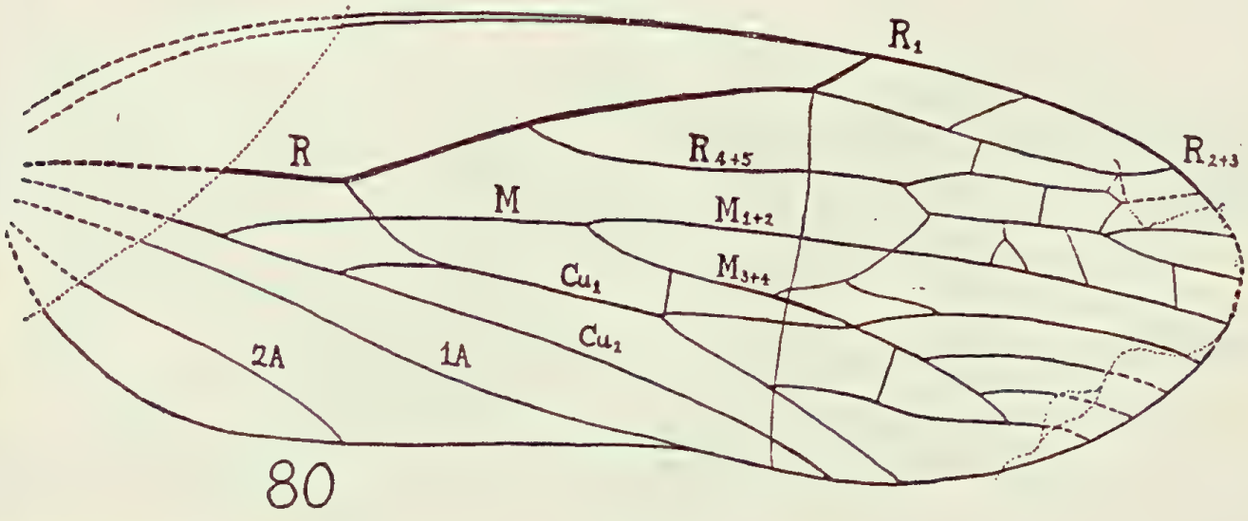
Tillyard, Proc. Linn. Soc. N.S.W., xliv., pt. 4, 1919 (1920), p. 873.

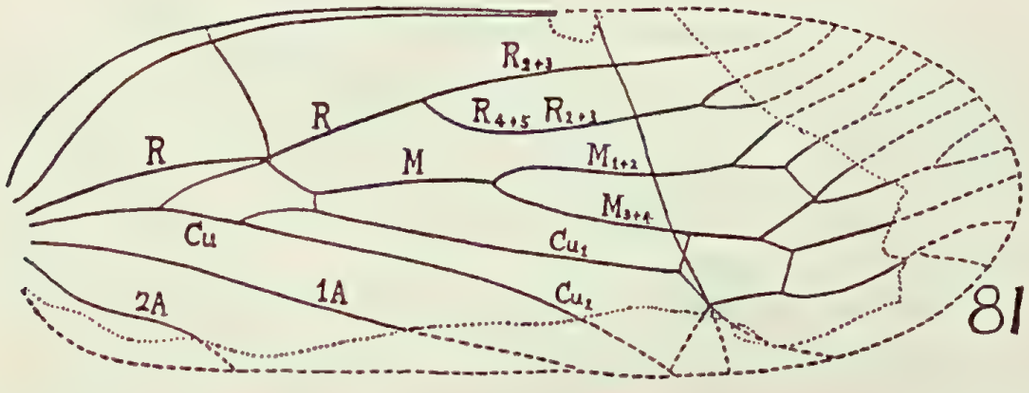
The type of this genus is *M. grandis* Till., represented by the basal half only of a large tegmen about 20 mm. long. Two more specimens referable to this genus are now to hand, and enable us to add to the definition of the genus the following characters:—Branches of R and M irregularly branched distally; a slightly impressed dividing line crossing the wing transversely from near end of R_1 to near end of clavus.

MESODIPHTHERA PROSBOLOIDES, n.sp. (Text-fig. 80.)

Greatest length of fragment, 14.4 mm; *greatest breadth,* 5 mm. The complete tegmen was probably about 15 mm. long.

This species is represented by the greater portion of a fairly large tegmen, evidently of stout build, but not very well preserved. The membrane is creased and cracked in places, making it very difficult to follow out the details of the venation, in which there are some very unexpected fusions of branch veins. The





Text-fig. 80.—*Mesodiphthera prosboloides*, n. sp. Tegmen restored. (x 7.5).
Text-fig. 81.—*Mesodiphthera dunstani*, n. sp. Tegmen restored. (x 11.6).

structure of the basal half of the tegmen resembles that of *M. grandis* Till., except that there is an oblique connecting vein between M and Cu_1, absent in the genotype, and Cu_1 is weakly formed and somewhat irregular. The costal area is broad basally, and shaped as in the genotype. R_1 appears as a short free vein

distally, arising obliquely from R_{2+3}, which is not well preserved. R_{4+5} is considerably branched. M_{1+2} is a strong, straight vein running to near apex, and having no branches. M_{3+4} gives off three anterior branches distally, and also meets two very oblique branches from Cu_1, the main stem of which is short, and ends up not far beyond the end of the clavus. Cu_2 is a straight furrow-vein. Most of the clavus is preserved, with 1A and 2A separate, and shaped much as in the genotype, though 2A is longer. The border of the clavus seems to be somewhat irregular in shape, but is not well preserved, and may have undergone some distortion.

Type, Specimen No. 89*a*, in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

MESODIPHTHERA DUNSTANI, n.sp. (Text-fig. 81.)

Greatest length of fragment, 10.8 mm.; *greatest breadth,* 3.8 mm. The complete tegmen was probably about 12 mm. long.

This species is complete basally, except for a small portion of the border of the clavus; the apical portion of the tegmen is broken off obliquely, but all the main branchings of the veins are well shown, though a considerable amount of transverse crumpling undergone by the tegmen makes them difficult to follow in places. The species is easily distinguished by the basal bending of M, which arches up so as to touch R, and then bends downwards again until it nearly touches Cu. Also all the distal branchings of R and M tend to turn upwards, and both branches of M are forked. Cu_1 is weakly formed, as in the previous species, but its manner of branching is different.

Family CIXIIDAE.

Genus MESOCIXIODES, n.g. (Plate liii., fig. 34; Text-figs. 82-84.)

Allied to *Mesocixius* Till., and also to *Triassocixius* Till., but differing from both in having R_1 unbranched, while R_{2+3} sends a series of veinlets to the costa distally. Costal area very broad. Median cell (*mc*) complete, small, and placed far distally, as in *Mesocixius*. Cu_1 with a small distal fork.

Genotype, *Mesocixiodes termioneura,* n.sp. (Upper Triassic, Ipswich, Q.).

MESOCIXIODES TERMIONEURA, n.sp. (Plate liii., fig. 34; Text-fig. 82.)

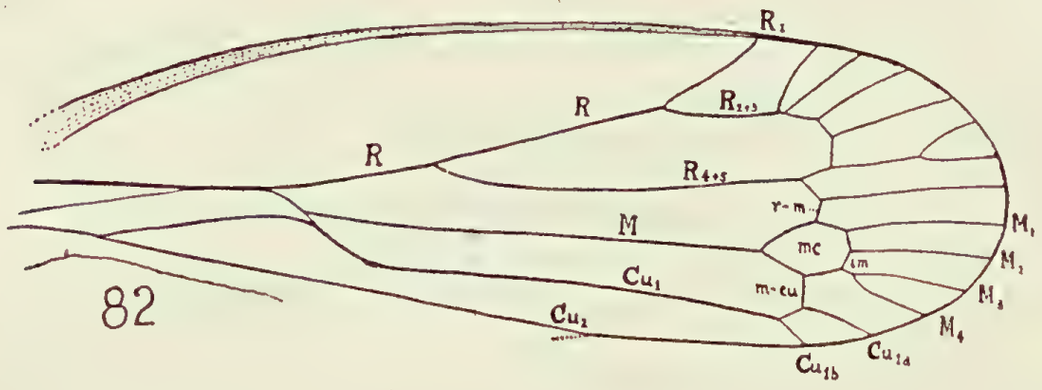
Total length, 12.5 mm.; width at end of clavus, 3.5 mm. The tegmen is complete except for the absence of the clavus and a slight break near the apex of the wing; it is finely granulated all over, and is stained a bright orange-brown. R_1 is a short vein, slightly curved, and somewhat similar to the terminal branches of R_{2+3}, though more strongly formed. R_{2+3} gives off altogether four terminal branches, the first two of which arise close together. R_{2+3} and R_{4+5} are connected distally by a strong cross-vein, and a similar R_{4+5} branches into two distally, the upper branch having a short terminal fork. cross-vein, *r-m,* connects R_{4+5} with the closed median cell below it. M_1 and M_2 are sessile upon the median cell (*mc*), M_3 and M_4 shortly stalked from it. A strong cross-vein, *m-cu,* connects the median cell with the short Cu_{1a} below it. There are no cross-veins present in the broad costal area, nor in the spaces between the main veins, except the three distal ones already mentioned, together with *im,* which closes the median cell.

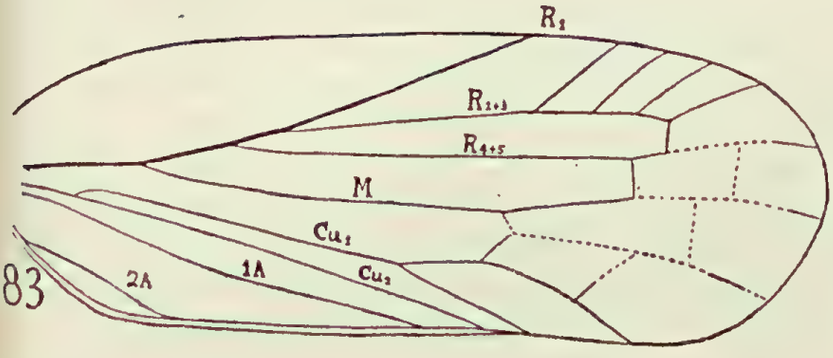
Type, Specimen 88*a*, in Coll. Queensland Geol. Survey, Brisbane.

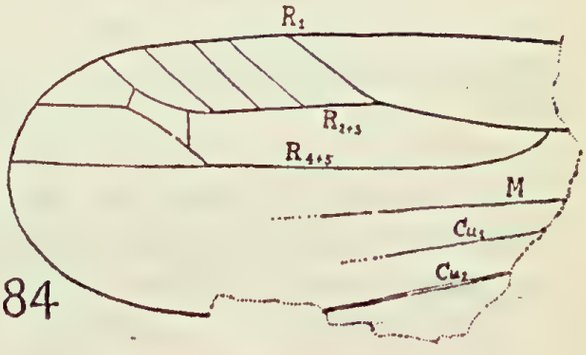
Horizon, Upper Triassic, Ipswich, Q.

MESOCIXIODES ORTHOCLADA, n.sp. (Text-fig. 83.)

Total length, 9 mm.; *greatest breadth,* 3.2 mm. This specimen is complete, except for partial obliteration of the distal portion. The costal area is broad, as in the genotype, but R_1 is a much longer vein, running straight out from the main stem of R in an oblique direction to a point about three-fifths of the way







Text-fig. 82.—*Mesocixiodes termioneura*, n.g. et sp. Tegmen. (*see* Plate liii., fig. 34.) (x 6.7).

Text-fig. 83.—*Mesocixiodes orthoclada*, n.g. et sp. Tegmen. (x 8).

Text-fig. 84.—*Mesocixiodes brachyclada*, n.g. et sp. Fragment of tegmen. (x 5).

along the costa, and thus making the costal area very pointed distally. Four evenly-spaced branches of R_{2+3} are present, and this vein leaves the main stem of R very close to R_{4+5}. M does not appear to be connected with Cu_1 basally, and its distal branches are very indistinct, though the median cell appears to be an elongated cell enclosed between only two main branches. The distal forking of Cu_1 is much longer than in the genotype. Clavus complete, with 1A running below and close to Cu_2 and very slightly waved; 2A a small loop across the anal angle.

Type, Specimen No. 318*a*, in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

In the absence of any definite evidence as to the true form of the median cell, it seems best to keep this species in the genus *Mesocixiodes*, with which it agrees in its other characters. The species is easily distinguished by the striking form of R_1, which has suggested the specific name *orthoclada*.

MESOCIXIODES BRACHYCLADA, n.sp. (Text-fig. 84.)

This species is represented only by the distal half of a left tegmen of about the same size as that of the previous species, having the four distal branches of

R_{2+3} similarly situated, but the first of them much closer to R_1, which is a short vein like that in the genotype, but quite straight. The end branch of R_{2+3} is gently curved, and is joined to an anterior branch of R_{4+5} by two short cross-veins. R_{2+3} and R_{4+5} come off far apart, as in the genotype. Branches of M and Cu_1 obliterated; Cu_2 apparently a rather stout vein. Length of fragment, 9.5 mm.

Type, Specimen No. 325*a* in Coll. Queensland Geol. Survey, Brisbane. Specimen No. 4, figured by me in 1916 (*l.c.*, Plate 1, fig. 5) as doubtfully belonging to *Mesorthopteron locustoides* Till., belongs to this species also, but the venation is very poorly preserved.

Horizon, Upper Triassic, Ipswich, Q.

Family IPSVICIIDAE.

Genus IPSVICIOPSIS, n.g. (Plate liii., fig. 35; Text-figs. 85, 86.)

Closely allied to *Ipsvicia* Till. from the same horizon, but differing from it in having an anterior branch of R present, which I have labelled R_1 in the figures, though it may perhaps represent R_{2+3} with R_1 suppressed. The tegmen is also of more normal shape, with a less acute apex and much less prominent anal angle of the clavus. Distally R and M are irregularly branched. Cu_1 is curved as in *Ipsvicia*, but runs much closer to Cu_2. The claval Y-vein is present, but its stem and the distal portion of its posterior arm (2A) are scarcely removed at all from the border of the wing. There are no patches of raised tubercles present, but the tegmen is finely and evenly granulated all over.

Genotype, *Ipsviciopsis elegans*, n.sp. (Upper Triassic, Ipswich, Q.).

IPSVICIOPSIS ELEGANS, n.sp. (Plate liii., fig. 35; Text-fig. 85.)

Total length, 12.5 mm.; *greatest breadth*, 3.8 mm. The specimen is a practically complete left tegmen, obverse impression, which has been turned round in Text-fig. 85, so as to bring the apex to the right. A small piece at the base of the costa has become somewhat detached from the rest of the wing, as may be seen in Plate liii., fig. 35, but has been replaced in Text-fig. 85. There is also some slight abrasion of the angle of the clavus. Rs and M are connected distally by three cross-veins, enclosing between them two elongated polygonal cells; above these is another cell formed by the branching of Rs distally, and closed by another cross-vein. Small branches from Rs and M form a series of irregular and mostly very small cells along the apical margin. M_{3+4} unites with Cu_1, which is unbranched, thus leaving a large open space below M_{1+2}. The whole tegmen is stained a rich orange-brown.

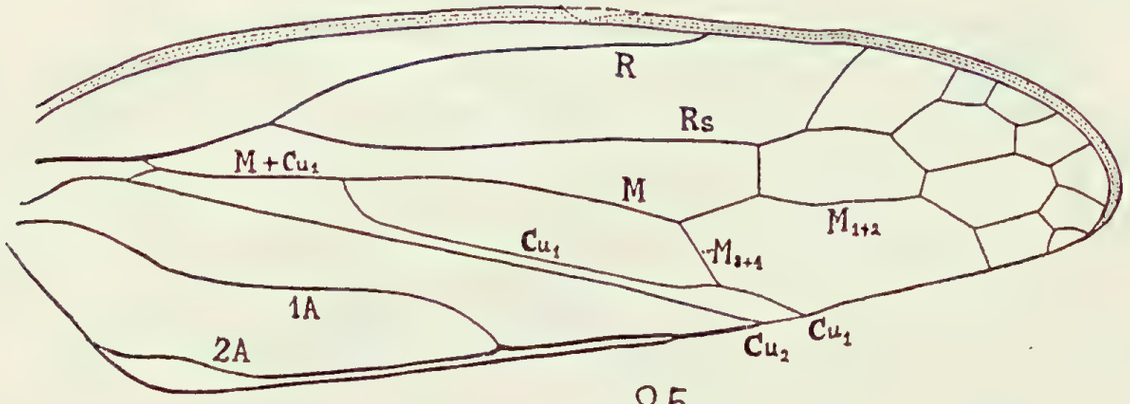
The above description applies to Specimen No. 178*a*, which is the type. Specimen No. 278*a* is another practically complete tegmen of this same species. It is the obverse of a right tegmen, complete except for an oblique depression in the rock, which runs across the distal portion of the wing, and has caused some abrasion in the depressed portion. The venation is almost exactly the same as in the type, there being only some slight differences in the size and position of the distal cells.

Types, Holotype, Specimen No. 178*a*; paratype, Specimen No. 278*a*. Both in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

IPSVICIOPSIS MAGNA, n.sp. (Text-fig. 86.)

This species is represented by a fragment of a right tegmen, reverse impression, measuring 10 mm. in length, and obviously belonging to a large tegmen, probably about 26 mm. in total length. It is very much cracked and



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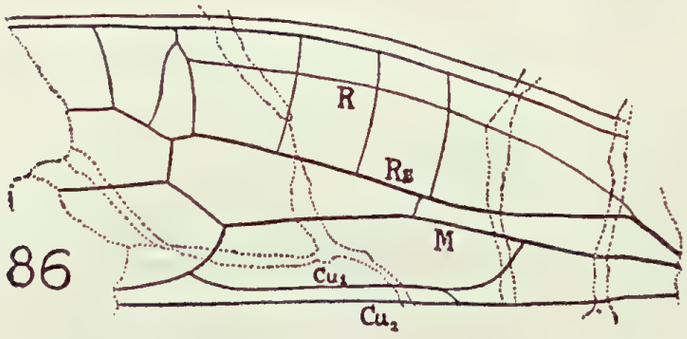

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Text-fig. 85.—*Ipsviciopsis elegans*, n.g. et sp. Type tegmen restored, with apex to right. (*see* Plate liii., fig. 35.) (x 7.9).

Text-fig. 86.—*Ipsviciopsis magna*, n.g. et sp. Fragment of tegmen. (x 6).

broken transversely, possibly owing to its toughness and may have been cracked under pressure. It differs markedly from the previous species in possessing a series of transverse veinlets running from Rs across R1 to the costa. R1 ends up on the fourth of these, which is joined near the costa by the fifth, these two arising one on each side of the strong cross-vein connecting Rs with M. A sixth veinlet is shown distally from Rs to the costal margin. R is also connected more basally with M by a short cross-vein, absent in the previous species; and a small cross-vein, obliquely placed, connects Cu1 with Cu2 at about the same level. Clavus and distal portion of the wing missing, as well as the extreme base.

Type, Specimen No. 93*a*, in Coll. Queensland Geol. Survey, Brisbane.
Horizon, Upper Triassic, Ipswich, Q.

Suborder **Heteroptera.**

Division *GYMNOCERATA.*

Family DUNSTANIIDAE.

Specimen 119*a* is a hemelytron belonging to this family, probably to *Dunstaniopsis triassica* Till., but not well enough preserved for accurate determination. The greater portion of the corium is visible, with the stems and branches of M and Cu, but all the margins are destroyed. The clavus and membrane are mostly obliterated.

Division *CRYPTOCERATA.*

Family TRIASSOCORIDAE, n.fam.

Insects resembling the Naucoridae and Galgulidae in the form of the hemelytron, which is broad, with a strongly projecting clavus reaching half-way or less along the posterior margin, and strongly angulated. Tegmen smooth, dark and shiny, as in Naucoridae, and not tough or marked with paler patches as in Galgulidae; the main veins R, M and Cu_1 are still visible on the corium, which extends over the greater portion of the hemelytron and is separated from the narrow distal membrane by a definitely impressed line, more or less concentric with the wing-border. In the region of the membrane above the apex, R and M give off a series of radiating branches which cross the membrane at close and regular intervals; most of these are only faintly outlined. These characters agree with those of the Belostomatidae of the present day, from which the fossil family is distinguished by its much smaller size and different shape. It would appear to be ancestral to the three families Galgulidae, Naucoridae and Belostomatidae, and perhaps to all the rest of the Cryptocerata also.

Genus TRIASSOCORIS, n.g. (Text-figs. 87, 88.)

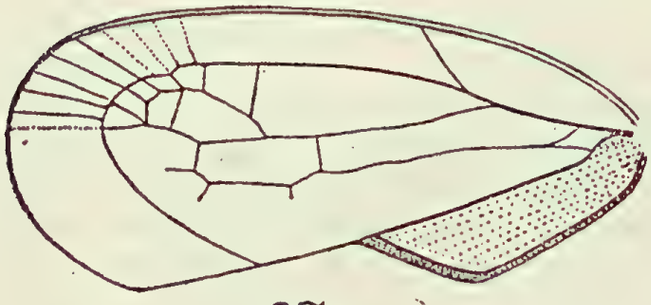
Hemelytron short, broad, quite smooth in texture, shiny and also very darkly coloured. Venation mostly very faintly marked, only three main veins apparent on the corium, viz., R, M and Cu_1. R and M are fused basally for some distance. R runs about parallel with the costal margin, a considerable distance from it; about one-third from base, it gives off a faint oblique veinlet, which is probably the first of the series of radiating veinlets continued around the apex, but mostly too weakly formed to be made out with certainty. M and Cu_1 both very faint, becoming irregular distally, and breaking up into small branchlets, most of which are too faint to be indicated accurately in the figure. Below Cu_1 there is an appearance of a very faint, irregular, polygonal meshwork; this is more clearly marked in specimen 167*b* than it is in specimen 140. The division between corium and membrane distally is indicated by a curved line running round from the end of R concentrically with the rounded apical margin. In the region of the apex, especially above it, a series of radiating veinlets can be seen crossing the membrane; they are clearly branches of R and M which cross the concentric line above mentioned. Clavus short and broad, strongly angulated, and ending up about half-way along the posterior margin of the wing, with which it makes a very marked angle. The position of the two hemelytra on the back of the insect when at rest is shown in Text-fig. 88, the shaded portions being the two clavi.

Genotype, *Triassocoris myersi*, n.sp. (Upper Triassic, Ipswich).

TRIASSOCORIS MYERSI, n.sp. (Text-figs. 87, 88.)

Total length, 5.8 mm.; *greatest breadth*, 2.5 mm. Hemelytron broad and well rounded apically; the corium and membrane quite smooth, apparently shiny in life, and probably of a very dark colour, since specimen 140 is very much darker than the rock on which it lies, but is clearly not carbonised. The venation of the corium is very faint, but the courses of M and Cu_1 upon it can just be made out in a strong oblique light, as well as a small portion of the polygonal meshwork, in specimen 140; in specimen 167*b*, this meshwork is more clearly marked, and very irregular in form.

This species is dedicated to my friend Mr. J. G. Myers, F.E.S., Assistant Entomologist, Biological Laboratory, Wellington, N.Z., who is doing excellent work on New Zealand Hemiptera.



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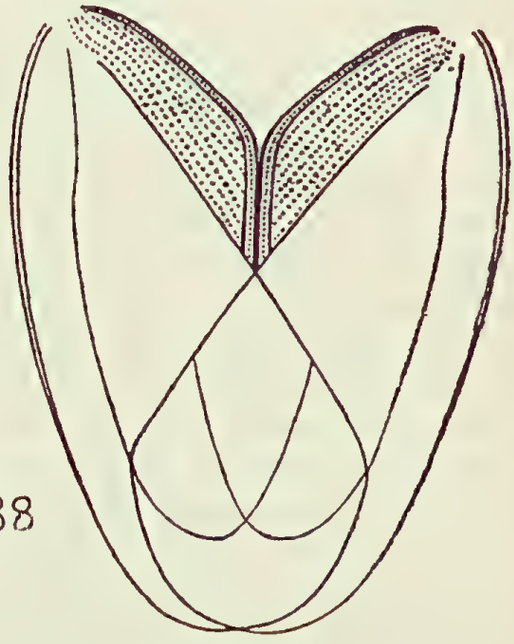

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Text-fig. 87.—*Triassocoris myersi*, n.g. et sp. Tegmen. (x 9.6).
Text-fig. 88.—*Triassocoris myersi*, n.g. et sp. The two tegmina placed in the position of rest. (x 9.6).

Types, Specimen 140*a* (corium and membrane) and 167*b* (clavus), in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

TRIASSOCORIS SCUTULUM, n.sp.

Specimen No. 134 contains two impressions of different insects, one being a portion of the tegmen of a Cockroach belonging to the genus *Samaroblatta* Till., not sufficiently well preserved to merit a name, and the other the two hemelytra of a species of *Triassocoris* folded over in the position of rest, as shown in Text-fig. 88, which was reconstructed from the previous species. The present species differs from the genotype in having the hemelytra much less rounded apically; so that, when folded in the position of rest, their appearance is more pointed apically, the figure being shield-shaped. Besides this, it can be seen that the course of R and the dividing vein which continues it between corium and membrane does not run concentrically with the margin but begins at the base comparatively close to the costa, and gradually diverges from it towards the apex. The hemelytra are irregularly broken off basally, but most of the two clavi can be seen *in situ*; the venation is practically obliterated.

Type, Specimen No. 134 in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Specimen No. 184*b* also appears to belong to this genus, but is too poorly preserved for description.

Order **NEUROPTERA.**

Suborder **Planipennia.**

Family PSYCHOPSIDAE.

Genus TRIASSOPSYCHOPS, n.g. (Plate lii., fig. 32; Text-fig. 89.)

Forewing very broad, the apex rounded, but less so than in most recent Psychopsidae, the tornus broadly rounded. Sc, R_1 and Rs very strongly built

from base to a little beyond half-way, forming a true *vena triplica,* characteristic of this family, and joined distally by two strong cross-veins; beyond this point, these three veins continue a short distance, when they are again connected by two cross-veins; at this point, Sc divides into terminal veinlets; R_1 and Rs continue a little further, when they are again connected by a cross-vein, after which Rs divides into terminal veinlets; R_1 divides into such between the second and third cross-veins. Of the three veins forming the vena triplica, Sc is much the strongest, R_1 the weakest. Costal area broad, a little broader than the area covered by Cu and the anal veins, but not so broad as in recent forms; a recurrent veinlet present at its base, sending a number of branches to the margin; the succeeding costal veinlets lie close together, mostly arising from Sc at an angle of about 45°, mostly branched, and connected here and there by small cross-veins, which show no tendency to become arranged into a costal series of gradate cross-veins, such as occurs in many recent forms. Apical area missing in the fossil, but its extent can be inferred from the length of the pectinate branches of Rs, some of which are preserved right to the margin of the wing; the actual shape of the apex can also be inferred from the comparative width of the costal margin and slant of the costal veinlets. Rs with about fourteen branches descending from the vena triplica, some branched and some simple within the area of the disc, but all branching closely towards the distal margin of the wing. M apparently with five branches within the area of the disc, and connected with the lowest branch of Rs by a strong oblique cross-vein. No fusion of M with Cu_1 distally. Cu_1 strongly formed, remaining unbranched for about three-fifths of its length, and then giving off numerous branches to the area of the tornus. Cu_2 a weakly-formed vein lying closely parallel below Cu_1, giving off a series of branches from about half-way, and bending strongly down distally below the point where Cu_1 gives off its first branch. 1A and 2A slightly arched veins branching longitudinally; 3A not present as a vein distinct from 2A basally. Posterior margin of the wing not strongly arched outwards at base. Cross-veins present in the vena triplica, strongly formed, spaced irregularly at fairly wide intervals. Numerous weak cross-veins present in the disc, especially in the basal half and between the branches of M almost to the distal margin; there are also weak cross-veins present between most of the outer branches of Rs at about two-thirds of the wing-length from the base; these show a tendency to arrangement as a true gradate series separating the disc from the marginal area; the latter is practically devoid of cross-veins, the cubito-anal area completely so.

Genotype, *Triassopsychops superba,* n.sp. (Upper Triassic, Ipswich, Q.).

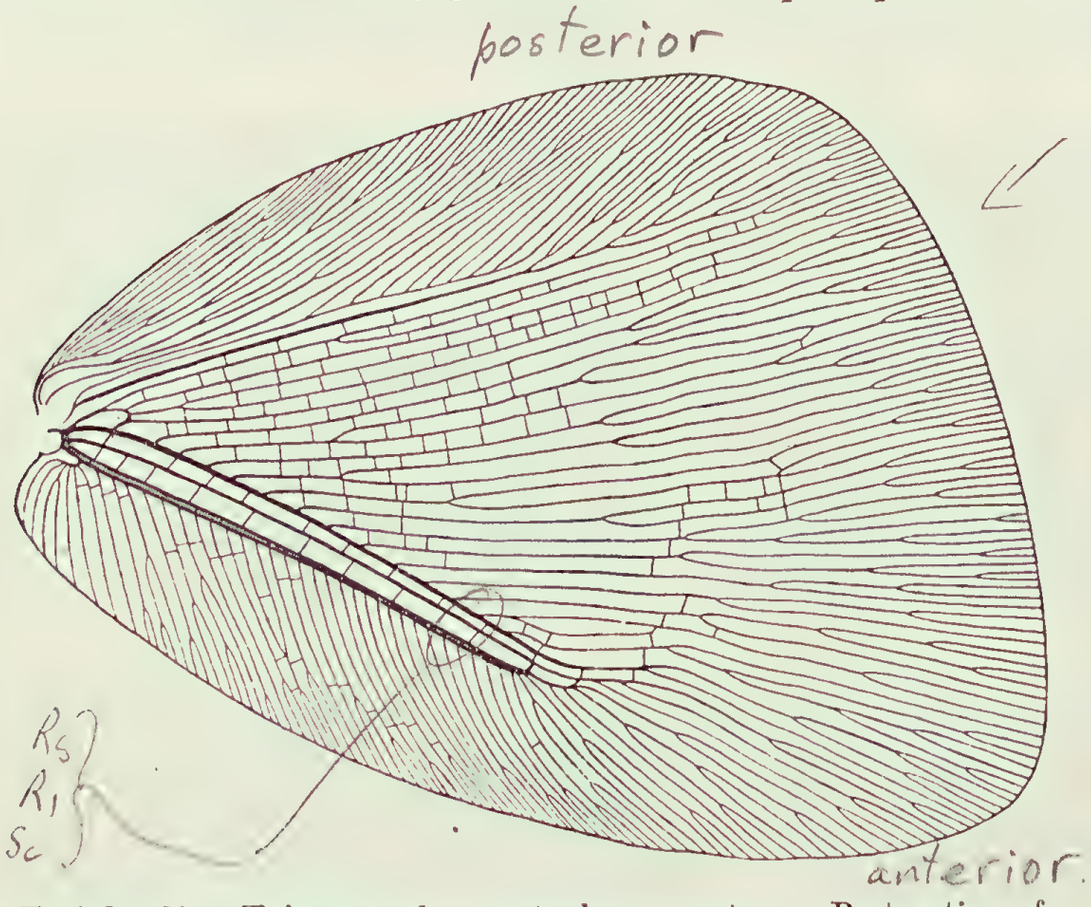
This genus differs from *Archepsychops* Till. in its less expanded costal area, in having R_1 and Rs separate right from the base, and not curved downwards markedly away from Sc, and also in having Cu_1 straight at the base, not arching sharply downwards, and making a smaller angle of divergence with Sc than in *Archepsychops.* This latter genus was placed by me, with *Protopsychopsis,* in the family Prohemerobiidae; but it seems probable, on the evidence offered by the new fossil, that it too would possess a true vena triplica of the Psychopsid type, and should therefore be placed within the family Psychopsidae. *Protopsychopsis* on the other hand must remain in the Prohemerobiidae, since the form of its apical area shows that a true vena triplica was not present.

The discovery of this magnificent fossil, complete in all the more important details of venation, enables us to state definitely that true Psychopsidae were

present in the Upper Triassic fauna of Ipswich. The more primitive condition of the fossil wing, compared with recent forms, and especially noticeable in the less rounded apex, less expanded costal area, and absence of any definite or complete gradate series of cross-veins, makes it necessary to place *Triassopsychops* by itself in a new subfamily Triassopsychopinae, which may possibly also include the genus *Archepsychops,* when more of the venation of that genus is made known.

TRIASSOPSYCHOPS SUPERBA, n.sp. (Plate lii., fig. 32; Text-fig. 89.)

Greatest length of fragment (obliquely along lower branches of Rs), 29 mm., representing a total length of 32 mm. *Greatest breadth of fragment,* 22 mm., representing a true greatest breadth of the complete wing, near tornus, of about 23.5 mm. The fossil is beautifully preserved, but the apical portion of the wing



Text-fig. 89.—*Triassopsychops superba*, n.g. et sp. Restoration of forewing. (*see* Plate lii., fig. 32.) (x 3).

is missing, and there are also irregular breaks along the costal and posterior margins. The more important details of venation have been included in the generic definition; the lesser details of the branching of the veins may be gathered from Plate lii., fig. 32. Text-fig. 89 shows a restoration of the complete wing, based on the photograph shown in the Plate.

Type, Specimen No. 284*a,* in Coll. Queensland Geol. Survey, Brisbane.

Horizon, Upper Triassic, Ipswich, Q.

Order **COLEOPTERA.**

The numerous specimens belonging to this Order, chiefly separate elytra, but some few showing the body of the insect with the wings *in situ,* are being worked up by Mr. Dunstan, and will be dealt with in a separate part. There is, however, one specimen of great interest which may be dealt with here, since

it does not require a name. It is Specimen No. 170, which shows the stem of a plant in which there can be plainly seen the mine or burrow of an insect larva. The type of burrow is clearly Coleopterous, and the larva probably belonged to one of the obscure families of very small beetles, the burrow being far too small to be that of a Cerambycid. It is shown in Plate li., fig. 29.

EXPLANATION OF PLATES LI.-LIII.

Plate li.

Fig. 26.—*Mesorthopteron locustoides* Till. Forewing, specimen No. 258*b*. (x 5).
Fig. 27 —*Triassomantis pygmaeus*, n.g. et sp. Forewing. (x 10.5).
Fig. 28.—*Triassolocusta leptoptera*, n.g. et sp. Forewing. (x 5.1).
Fig. 29.—Burrow of Coleopterous larva in stem of plant. (x 6.2).

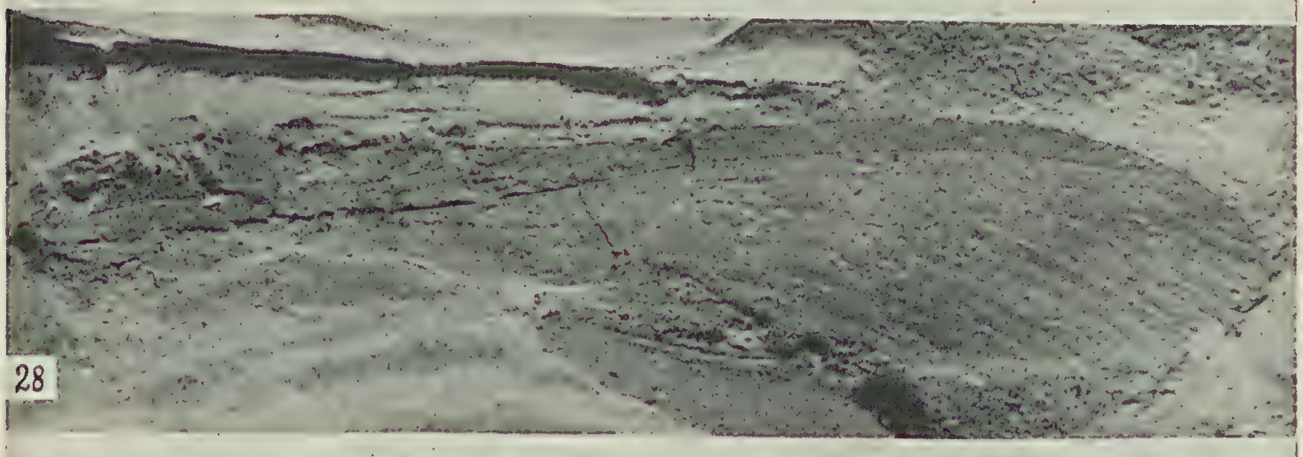
Plate lii.

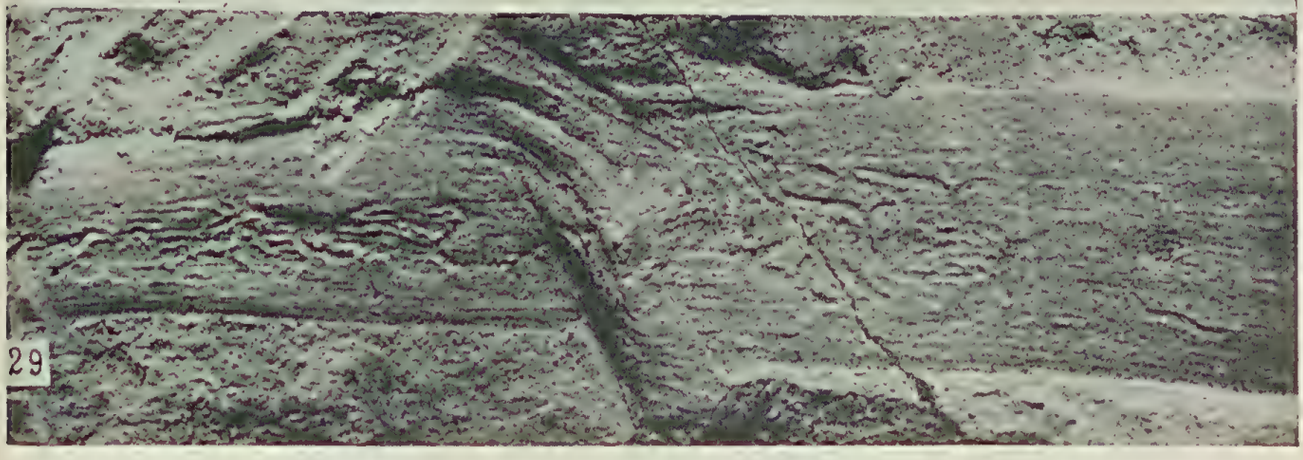
Fig. 30.—*Mesophlebia antinodalis* Till. Heautotype. (x 4).
Fig. 31.—*Triassagrion australiense*, n.g. et sp. (x 4).
Fig. 32.—*Triassopsychops superba*, n.g et sp. (x 4.2).

Plate liii.

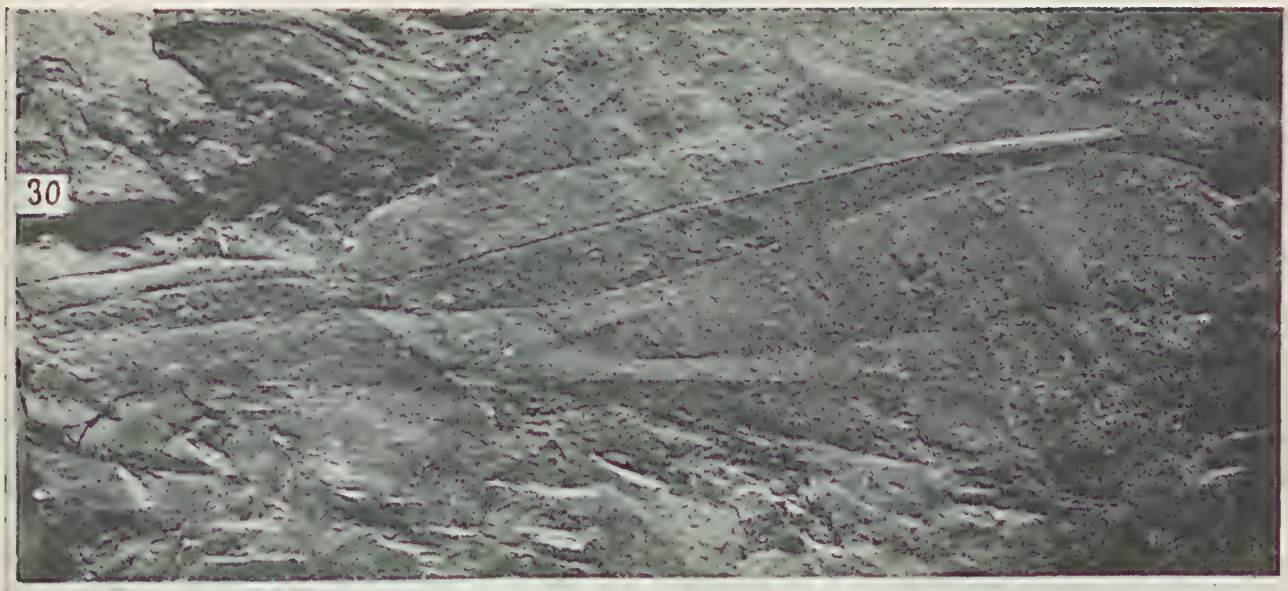
Fig. 33.—*Apheloscyta mesocampta*, n.g. et sp. Tegmen. (x 8.85).
Fig. 34.—*Mesocixiodes termioneura*, n.g. et sp. Tegmen. (x 7.6).
Fig. 35.—*Ipsviciopsis elegans*, n.g. et sp. Tegmen. (x 7.5).
Fig. 36.—*Polycytella triassica*, n.g. et sp. Tegmen. (x 11).
Fig. 37.—*Chiliocycla scolopoides* Till. Tegmen. Type. (x 10).

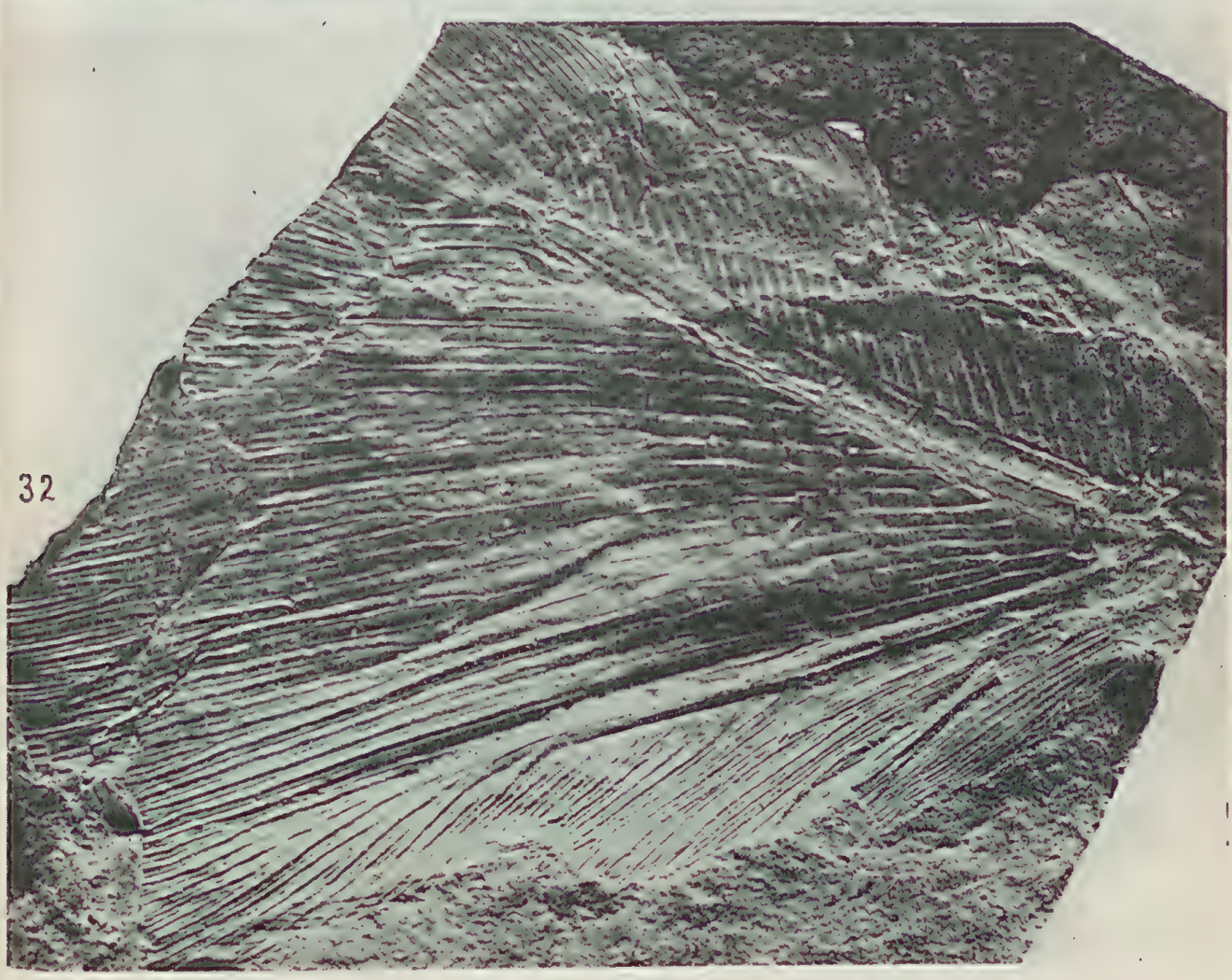
(N.B.—The numbers of the figures run concurrently with those of the previous Part).





26. *Mesorthopteron locustoides.*
27. *Triassomantis pygmaeus.*
28. *Triassolocusta leptoptera.*
29. Burrow of Coleopterons larva.





30. *Mesophlebia antinodalis.* 31. *Triassagrion australiense.*
32. *Triassopsychops superba.*

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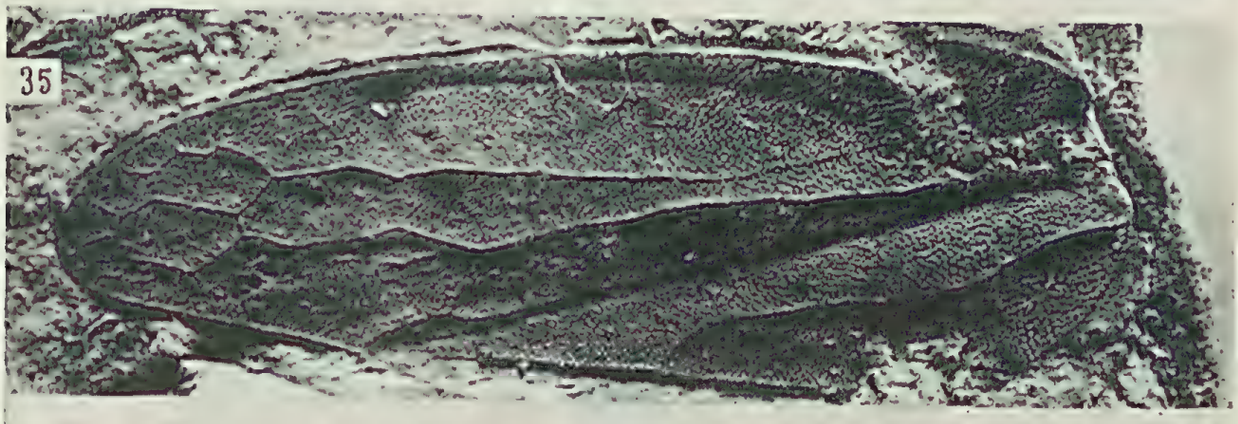

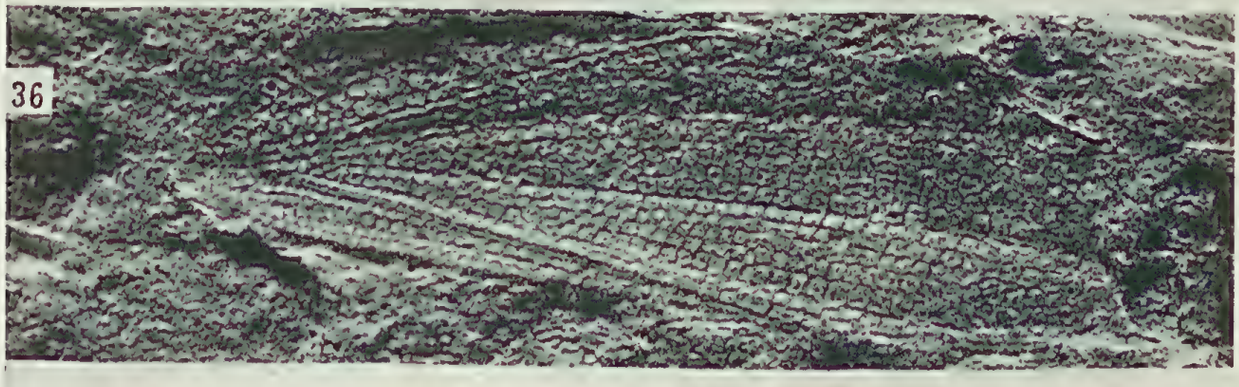

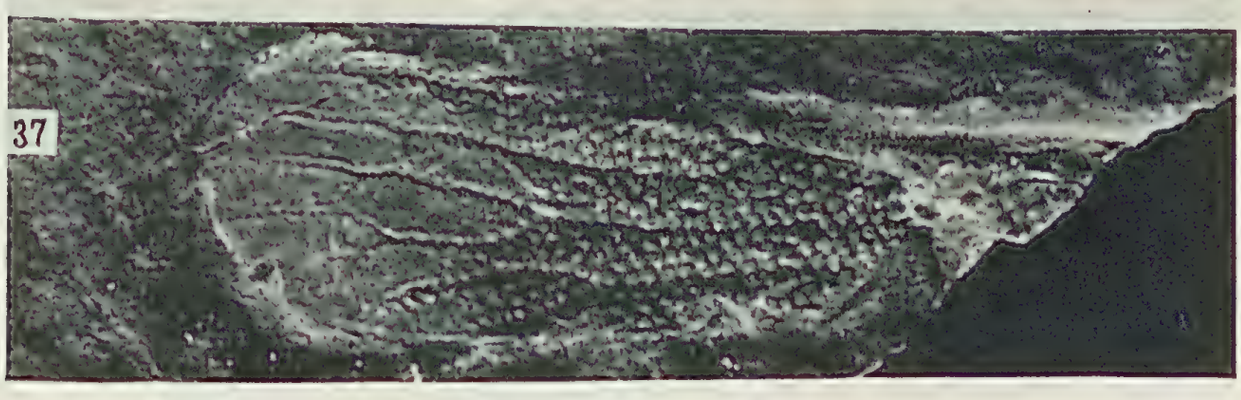

33. *Apheloscyta mesocampta.*
34. *Mesocixiodes termioneura.*
35. *Ipsviciopsis elegans.*
36. *Polycytella triassica.*
37. *Chiliocycla scolopoides.*

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MESOZOIC INSECTS OF QUEENSLAND.

No. 10. Summary of the Upper Triassic Insect Fauna of Ipswich, Q. (With an Appendix describing new Hemiptera and Planipennia).

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(Plate xliii., figs. 38-40; Text-figs. 90-93.)

[Read 31st October, 1923.]

With the addition of a few forms dealt with as an Appendix to this paper, the publication of Mr. Dunstan's work on the Coleoptera (1923) brings to a close the work on the extensive collections of Upper Triassic fossil insects found at Denmark Hill, Ipswich, Q. We are, therefore, now in a position to summarize these results, and to draw conclusions from them as to the age of the beds and the composition of the fauna disclosed in them. With this end in view, I propose to give, first of all, a complete list of the Orders, families, genera and species described from Ipswich, and then to discuss the results. The list here given differs slightly from the detailed results as published in the various parts, as follows:—

(1). After further study of the Order Protodonata, I am unable to admit the retention of the genus *Aeroplana* in this Order. This type of wing appears to be a highly specialised offshoot from the old Palaeodictyoptera, showing some affinities with the Protorthoptera on account of the structure of the much simplified radial sector and the many-branched media. I propose, therefore, to treat the Aeroplanoptera as a distinct Order rather than as a Suborder of the Protodonata.

(2). Two new species of *Triassocoris* and a new genus and species belonging to the Order Neuroptera-Planipennia are described in the Appendix to this paper, and are included in the list, bringing the total number of species up to 122, belonging to 63 genera, 32 families, and 10 Orders, as shown in the following list. Genotype species are marked with an asterisk. For references, *see* bibliography at end of this paper.

List of Fossil Insects from the Upper Triassic Beds of Denmark Hill, Ispwich, Q.

Order Aeroplanoptera.

Family Aeroplanidae.

Genus Aeroplana Till., 1918*b*, p. 426.

**Aeroplana mirabilis* Till., 1918*b*, p. 426.

Order ODONATA.

Sub-order *Archizygoptera.*

Family Triassagrionidae.

Genus TRIASSAGRION Till., 1922, p. 455.

**Triassagrion australiense* Till., 1922, p. 456.

Sub-order *Anisozygoptera.*

Family Mesophlebiidae.

Genus MESOPHLEBIA Till., 1916, p. 24; 1922, p. 452.

**Mesophlebia antinodalis* Till., 1916, p. 25; 1922, p. 452.

Genus TRIASSOPHLEBIA Till., 1922, p. 454.

**Triassophlebia stigmatica* Till., 1922, p. 454.

Family Triassolestidae.

Genus TRIASSOLESTES Till., 1918*b*, p. 418.

**Triassolestes epiophlebioides* Till., 1918*b*, p. 419.

Incertae sedis.

Genus PERISSOPHLEBIA Till., 1918*b*, p. 422.

**Perissophlebia multiseriata* Till., 1918*b*, p. 424.

Order PROTORTHOPTERA.

Family Mesorthopteridae.

Genus MESORTHOPTERON Till., 1916, p. 14; 1922, p. 448.

**Mesorthopteron locustoides* Till., 1916, p. 14; 1922, p. 448.

Family Mesomantidiidae.

Genus MESOMANTIDION Till., 1916, p. 16.

**Mesomantidion queenslandicum* Till., 1916, p. 16.

Order ORTHOPTERA.

Sub-order *Blattoidea.*

Family Mylacridae.

Genus AUSTROMYLACRITES Till., 1916, p. 13.

**Austromylacrites latus* Till., 1916, p. 13.

Family Mesoblattinidae.

Genus TRIASSOBLATTA Till., 1919*b*, p. 367.

**Triassoblatta typica* Till., 1919*b*, p. 368.

Triassoblatta insignita Till., 1919*b*, p. 370.

Triassoblatta (?) intermedia Till., 1919*b*, p. 371.

Genus SAMAROBLATTA Till., 1919*b*, p. 373.

**Samaroblatta reticulata* Till., 1919*b*, p. 374.

Samaroblatta triassica Till., 1919*b*, p. 375.

Samaroblatta jonesi Till., 1919*b*, p. 376.

Samaroblatta blattelloides Till., 1919*b*, p. 377.

Samaroblatta intercalata Till., 1919*b*, p. 379.

Genus AUSTROBLATTULA Till., 1919*b*, p. 380.

**Austroblattula ipsviciensis* Till., 1919*b*, p. 381.

Sub-order *Mantoidea.*

Family Triassomantidae.

Genus TRIASSOMANTIS Till., 1922, p. 450.

**Triassomantis pygmaeus* Till., 1922, p. 450.

Sub-order *Locustoidea.*

Family Locustopsidae.

Genus Triassolocusta Till., 1922, p. 451.

**Triassolocusta leptoptera* Till., 1922, p. 451.

Order Hemiptera.

Sub-order *Homoptera.*

Family Mesogereonidae.

Genus Mesogereon Till., 1916, p. 33; 1921, p. 273.

**Mesogereon neuropunctatum* Till., 1916, p. 34; 1921, p. 273.

Mesogereon superbum Till., 1921, p. 274.

Mesogereon compressum Till., 1921, p. 277.

Mesogereon affine Till., 1921, p. 277.

Mesogereon shepherdi Till., 1921, p. 279.

Family Cicadellidae.

Genus Mesojassus Till., 1916, p. 34; 1920, p. 885.

**Mesojassus ipsviciensis* Till., 1916, p. 35; 1920, p. 886.

Genus Eurymelidium Till., 1920, p. 884.

**Eurymelidium australe* Till., 1920, p. 885.

Genus Triassojassus Till., 1920, p. 887.

**Triassojassus proavitus* Till., 1920, p. 888.

Family Scytinopteridae.

Genus Mesoscytina Till., 1920, p. 871.

**Mesoscytina australis* Till., 1920, p. 871.

Mesoscytina affinis Till., 1920, p. 872.

Genus Triassoscarta Till., 1920, p. 874.

**Triassoscarta subcostalis* Till., 1920, p. 874.

Genus Apheloscyta Till., 1922, p. 458.

**Apheloscyta mesocampta* Till., 1922, p. 459.

Genus Chiliocycla Till., 1920, p. 868; 1922, p. 460.

**Chiliocycla scolopoides* Till., 1920, p. 869; 1922, p. 460.

Genus Polycytella Till., 1922, p. 460.

**Polycytella triassica* Till., 1922, p. 460.

Family Tropiduchidae.

Genus Mesodiphthera Till., 1920, p. 873; 1922, p. 461.

**Mesodiphthera grandis* Till., 1920, p. 873.

Mesodiphthera prosboloides Till., 1922, p. 461.

Mesodiphthera dunstani Till., 1922, p. 462.

Family Cixiidae.

Genus Mesocixius Till., 1920, p. 876.

**Mesocixius triassicus* Till., 1920, p. 877.

Genus Triassocixius Till., 1920, p. 878.

**Triassocixius australicus* Till., 1920, p. 878.

Genus Mesocixiodes Till., 1922, p. 462.

**Mesocixiodes termioneura* Till., 1922, p. 462.

Mesocixiodes orthoclada Till., 1922, p. 463.

Mesocixiodes brachyclada Till., 1922, p. 463.

Family Ipsviciidae.

Genus Ipsvicia Till., 1920, p. 878.

**Ipsvicia jonesi* Till., 1920, p. 879.

Ipsvicia maculata Till., 1920, p. 881.

Ipsvicia acutipennis Till., 1920, p. 883.
Genus IPSVICIOPSIS Till., 1922, p. 464.
**Ipsviciopsis elegans* Till., 1922, p. 464.
Ipsviciopsis magna Till., 1922, p. 465.

Sub-order *Heteroptera.*

Family Dunstaniidae.
Genus DUNSTANIA Till., 1916, p. 31; 1918*c*, p. 583.
**Dunstania pulchra* Till., 1916, p. 32; 1918*c*, plate.
Genus DUNSTANIOPSIS Till., 1918*c*, p. 584.
**Dunstaniopsis triassica* Till., 1918*c*, p. 585.
Genus PARADUNSTANIA Till., 1918*c*, p. 585.
**Paradunstania affinis* Till., 1918*c*, p. 586.

Family Triassocoridae.
Genus TRIASSOCORIS Till., 1922, p. 466.
**Triassocoris myersi* Till., 1922, p. 466.
Triassocoris scutulum Till., 1922, p. 467.
Triassocoris ovalis n.sp.
Triassocoris (?) *grandis* n.sp.

Order PROTOMECOPTERA

Family Archipanorpidae.
Genus ARCHIPANORPA Till., 1917, p. 191.
**Archipanorpa magnifica* Till., 1917, p. 191.

Order MECOPTERA.

Family Choristidae.
Genus MESOCHORISTA Till., 1916, p. 29.
**Mesochorista proavita* Till., 1916, p. 30.

Family Stereochoristidae.
Genus STEREOCHORISTA Till., 1919*a*, p. 196.
**Stereochorista frustrata* Till., 1919*a*, p. 197.

Order PARATRICHOPTERA.

Family Mesopsychidae.
Genus MESOPSYCHE Till., 1917, p. 181.
**Mesopsyche triareolata* Till., 1917, p. 182.
Genus TRIASSOPSYCHE Till., 1917, p. 182.
**Triassopsyche dunstani* Till., 1917, p. 184.
Genus ARISTOPSYCHE Till., 1919*a*, p. 200.
**Aristopsyche superba* Till., 1919*a*, p. 202.
Genus NEUROPSYCHE Till., 1919*a*, p. 203.
**Neuropsyche elongata* Till., 1919*a*, p. 204.

Order NEUROPTERA.
Sub-order *Planipennia.*

Family Prohemerobiidae.
Genus PROTOPYSCHOPSIS Till., 1917, p. 178.
**Protopsychopsis venosa* Till., 1917, p. 180.
Genus OSMYLOPSYCHOPS, n.g.
**Osmylopsychops spillerae*, n.sp.

Family Psychopsidae.
Genus ARCHEPSYCHOPS Till., 1919*a*, p. 205.

Archepsychops triassica Till., 1919*a*, p. 206.

Genus TRIASSOPSYCHOPS Till., 1922, p. 467.

Triassopsychops superba Till., 1922, p. 469.

Order COLEOPTERA.

Family Hydrophilidae.

Genus ADEMOSYNE Handl., 1906, p. 402.

Ademosyne major Handl., 1906, p. 402; Till., 1916, p. 19; Dunst., 1923, p. 15.

Ademosyne olliffi (Handl.), 1906, p. 402; Till., 1916, p. 19; Dunst., 1923, p. 12.

Ademosyne australiensis Till., 1916, p. 18; Dunst., 1923, p. 19.

Ademosyne congener Till., 1916, p. 20; Dunst., 1923, p. 22.

Ademosyne cameroni Till., 1916, p. 21; Dunst., 1923, p. 24.

Ademosyne punctata Till., 1916, p. 21; Dunst., 1923, p. 23.

Ademosyne parva Dunst., 1923, p. 13.

Ademosyne intermedia Dunst., 1923, p. 14.

Ademosyne lata Dunst., 1923, p. 15.

Ademosyne brevis Dunst., 1923, p. 17.

Ademosyne curvata Dunst., 1923, p. 18.

Ademosyne ramocostata Dunst., 1923, p. 19.

Ademosyne rugulosa Dunst., 1923, p. 20.

Ademosyne vittamargina Dunst., 1923, p. 21.

Ademosyne adunca Dunst., 1923, p. 23.

Genus ADEMOSYNOIDES Dunstan, 1923, p. 25.

Ademosynoides minor (Handl.), 1906, p. 403; Till., 1916, p. 20; Dunst., 1923, p. 26.

Ademosynoides obtusa (Till.), 1916, p. 19; Dunst., 1923, p. 26.

Ademosynoides angusta (Till.), 1916, p. 18; Dunst., 1923, p. 29.

Ademosynoides alternata Dunst., 1923, p. 27.

Ademosynoides striatella Dunst., 1923, p. 28.

Ademosynoides abnormis Dunst., 1923, p. 30.

Ademosynoides magnifica Dunst., 1923, p. 31.

Genus PLATYCROSSOS Dunstan, 1923, p. 32.

Platycrossos tumidus (Till.), 1916, p. 21; Dunst., 1923, p. 34.

Platycrossos ligulatus Dunst., 1923, p. 33.

Platycrossos subtumidus Dunst., 1923, p. 34.

Genus SIMMONDSIA Dunstan, 1923, p. 35.

Simmondsia subpyriformis Dunst., 1923, p. 36.

Simmondsia cylindrica Dunst., 1923, p. 37.

Genus GRAMMOSITUS Dunstan, 1923, p. 37.

Grammositus bilineatus Dunst., p. 38.

Genus SHEPHERDIA Dunstan, 1923, p. 38.

Shepherdia quadrivittata Dunst., 1923, p. 39.

Genus POLYSITUS Dunstan, 1923, p. 40.

Polysitus punctatus Dunst., 1923, p. 40.

Polysitus minutus Dunst., 1923, p. 42.

Family Tenebrionidae (?).

Genus ULOMITES Till., 1916, p. 22.

Ulomites willcoxi Till., 1916, p. 22; Dunst., 1923, p. 43.

Family Elateridae (?).

Genus Elateridium Till., 1918*a*, p. 751.

Elateridium subulatum (Dunst.), 1923, p. 44.

Elateridium transversum (Dunst.), 1923, p. 45.

Genus Elaterium Westwood, 1854 (Quart. Journ. Geol. Soc., x., p. 387).

Elaterium punctomarginum Dunst., 1923, p. 46.

Elaterium bipunctatum Dunst., 1923, p. 47.

Family Dermestidae (?).

Genus Reeveana Dunstan, 1923, p. 48.

**Reeveana major* Dunst., 1923, p. 48.

Reeveana intermedia Dunst., 1923, p. 49.

Reeveana minor Dunst., 1923, p. 50.

Genus Tryoniopsis Dunstan, 1923, p. 51.

**Tryoniopsis punctata* Dunst., 1923, p. 51.

Tryoniopsis granulata Dunst., 1923, p. 52.

Family Buprestidae (?).

Genus Mesostigmodera Eth. & Oll., 1890, p. 10; Handl., 1906, p. 402.

**Mesostigmodera typica* Eth. & Oll., 1890, p. 10; Handl., 1906, p. 402; Till., 1916, p. 22; Dunst., 1923, p. 56.

Genus Lobites Dunstan, 1923, p. 53.

**Lobites tuberculata* Dunst., 1923, p. 54.

Lobites trivittata Dunst., 1923, p. 53.

Lobites granulata Dunst., 1923, p. 55.

Family Cerambycidae (?).

Genus Mesothoris Till., 1916, p. 23.

**Mesothoris clathrata* Till., 1916, p. 23; Dunst., 1923, p. 58.

Mesothoris quadripartita Dunst., 1923, p. 60.

Mesothoris tenuiclathrata Dunst., 1923, p. 61.

Mesothoris grandis Dunst., 1923, p. 61.

Genus Willcoxia Dunstan, 1923, p. 62.

**Willcoxia magnopunctata* Dunst., 1923, p. 63.

Family Curculionidae (?).

Genus Etheridgea Handl., 1906, p. 402.

**Etheridgea australis* Handl., 1906, p. 402; Till., 1916, p. 24; Dunst., 1923, p. 68.

Genus Tillyardiopsis Dunst., 1923, p. 64.

**Tillyardiopsis tuberculata* Dunst., 1923, p. 65.

Tillyardiopsis granulata Dunst., 1923, p. 66.

Tillyardiopsis variotubercula Dunst., 1923, p. 67.

Family Dascillidae (?).

Genus Leioodes Dunstan, 1923, p. 68.

**Leioodes plana* Dunst., 1923, p. 69.

Leioodes pygmaea Dunst., 1923, p. 69.

Genus Apheloodes Dunstan, 1923, p. 70.

**Apheloodes obliqua* Dunst., 1923, p. 72.

Apheloodes rugosa Dunst., 1923, p. 71.

The composition of the above fauna is summarised in Table A.

Table A.

Table Showing the Numerical Composition of the Fauna.

Orders and Suborders.	Families.	Genera.	Species.	Percentage of Species.
Hemimetabolous Orders.				
Aeroplanoptera	1	1	1	0.8
Odonata	3	4	4	3.3
Protorthoptera	2	2	2	1.6
Orthoptera	4	6	12	9.8
Blattoidea	2	4	10	8.2
Mantoidea	1	1	1	0.8
Locustoidea	1	1	1	0.8
Hemiptera	8	19	34	27.9
Homoptera	6	15	27	22.2
Heteroptera	2	4	7	5.7
Holometabolous Orders.				
Protomecoptera	1	1	1	0.8
Mecoptera	2	2	2	1.6
Paratrichoptera	1	4	4	3.3
Neuroptera Planipennia	2	4	4	3.3
Coleoptera	8	20	58	47.6
Total (10 orders):—	32	63	122	100.0

Percentage of species of Hemimetabola:—43.4.
Percentage of species of Holometabola:—56.6.

The Geological Age of the Ipswich Beds.

The composition of the Insect Fauna of the Ipswich Fossil Beds affords very valuable evidence of the geological age of these beds. In order to make this evidence clear, I give below a Table (Table B.) comparing the percentages of the various Orders in the Ipswich Beds with those of the Belmont Beds, which are undoubtedly of Upper Permian Age, and the Liassic Beds of Europe. It will also be necessary to trace the evolution of certain test groups of insects to show how the percentage of such groups may be used as an aid in indicating the comparative ages of the beds.

Table B.

Table showing the Ordinal Percentages in the Belmont, Ipswich and European Liassic Insect Faunas.

Orders and Suborders.	Belmont.	Ipswich.	Liassic of Europe.
Hemimetabolous Orders.			
Aeroplanoptera	—	0.8	—
Odonata	—	3.3	5.2
Protorthoptera	—	1.6	—
Orthoptera	—	9.8	26.5
Blattoidea	—	8.2	7.4
Mantoidea	—	0.8	2.5
Locustoidea	—	0.8	16.6
Hemiptera	47.4	27.9	9.6
Homoptera	47.4	22.2	7.4
Heteroptera	0.0	5.7	2.2
Holometabolous Orders.			
Neuroptera Planipennia	5.3	3.3	4.3
Protomecoptera	5.3	0.8	—
Mecoptera	21.0	1.6	4.6
Paramecoptera	10.5	—	—
Paratrichoptera	—	3.3	—
Diptera	—	—	4.0
Trichoptera	—	—	4.0
Coleoptera	10.5	47.6	41.8
	100.0	100.0	100.0
Percentage of Hemimetabola	47.4	43.4	41.3
Percentage of Holometabola	52.6	56.6	58.7

N.B.—The above percentages are calculated on the following total numbers of species for each fauna:—Belmont, 19; Ipswich, 122; Lias, 324. The Lias includes both Lower and Upper Lias, together with some Rhaetic fossils, reckoned by Handlirsch as Lower Lias. The record of the European Triassic is too small and fragmentary to be of any use.

Referring to Table B., the following groups may be considered separately:—

(1). *Hemimetabola and Holometabola.* As is well known, the first winged insects were all Hemimetabolous, i.e., they did not possess a true pupal or resting stage. In the Upper Carboniferous, where the Insecta are first met with in the fossil state, the percentage of Hemimetabolous insects is 100.0, that of Holometabolous insects 0.0. The same holds good, apparently, for the Lower Permian of Europe. In studying some two thousand specimens recently sent to me from Yale University, taken from the Lower Permian of Kansas, I am able to recognise the oldest known Holometabolous insects in the form of some very small wings undoubtedly belonging to the Order Mecoptera; the percentage of these wings to the total is under 1 per cent. The first record that we have of the Holometabola being at all abundant is in the Upper Permian Beds of Belmont, N.S.W., where no less than ten out of the nineteen known species are Holometabolous, or 52.6 per cent. No doubt this percentage will be considerably altered when a larger number of wings have been taken from these beds; but the important point to be noted is that here, for the first time, we find the Holometabola firmly established, and approximately 50 per cent. of the total fauna.

As we pass upwards through the various epochs to the present time, the percentage of Holometabola steadily increases, while that of the Hemimetabola just as steadily diminishes. In the European Lias, 58.7 of the fossils are Holometabola, only 41.3 Hemimetabola. For the whole of the Tertiary Insect Beds, the percentage of Holometabola is 80.0, that of the Hemimetabola 20.0. For Recent Pterygote Insects, the percentage of Holometabola is 87.8, that of Hemimetabola 12.2. Thus we see that the older (Hemimetabolous) groups have steadily lost ground, while the newer (Holometabolous) groups have just as steadily gained.

Applying this result to the Ipswich fauna, we find that the percentages of Holometabola and Hemimetabola there lie *between* those of Belmont on the one hand and the European Lias on the other, but proportionately closer to the Lias than to the Belmont horizon, in the ratio of almost exactly two to one. Thus the Ipswich Beds fall, on this percentage, within the Upper Trias. If we take into account the probability that, even at this early date, some archaic groups (e.g., Aeroplanoptera and Protorthoptera) had found refuge in Australia, but were extinct in Europe, we should expect that a slightly increased percentage of Hemimetabola might be looked for in an Australian fossil bed as compared with a European fossil bed of the same age. If it is permissible to make a small allowance for this, we should then have to bring the horizon of the Ipswich Beds slightly nearer still to the Lias, i.e., to the top of the Upper Trias.

(2). *Blattoidea.* The Cockroaches are the most ancient of existing insects, and were present in great numbers in the Upper Carboniferous. In some Upper Carboniferous Beds (e.g., those of England and Germany) they are so abundant as to account for more than 90 per cent. of the total insect fauna; but this, as Pruvost has pointed out, is only where the fossilised fauna was one inhabiting a locality exceptionally suitable for the existence of these insects. In other localities, as at Commentry and Mazon Creek, the percentage is much less (20 per cent. or lower), but still very considerable. In the Lower Permian we find the same thing; in some beds Cockroaches make up the majority of the fauna; in others, the percentage is much smaller. Not long after the disappearance of the Coal-measure forests, the Cockroaches began to die out very rapidly; and from the beginning of the Mesozoic to the present day they have been a decreasing group, their percentage to the total being 0.7 in the Tertiary, and only 0.4 in Recent times.

No cockroaches were present, as far as known, in the Belmont Beds, and we can only assume that the group had not been dispersed far enough to have reached Australia in Upper Permian times. Cockroaches are, however, present at Ipswich, and belong almost exclusively to that group, viz., the family Mesoblattinidae, which is typical of the European Lias. The exception to this is the single genus *Austromylacrites,* which is a remnant of an old Carboniferous group, quite extinct in the European Lias. If, then, we compare the Cockroaches of the Ipswich Beds with those of the European Lias, we find that the former has distinctly the higher percentage, 8.2, as against 7.4 for the Lias, and that it is morphologically slightly more archaic. Thus we can only conclude that, judged by the Cockroaches, the Ipswich Beds are somewhat older than the Lias, and are rightly considered as Upper Triassic.

(3). *Odonata.* The true Dragonflies or Odonata first arose in the Lower Permian, where a single species has recently been discovered by me from the Kansas Beds. Apart from Ipswich, no other records of the Order are to be found until we come to the European Lias, where they are represented by a number of

interesting genera, forming a considerable percentage of the total insect fauna. (*Note*:—The percentage given in the Table does not include a number of new species recently described by me, but not yet published). These forms include no true Anisoptera, but only Zygoptera and an intermediate Suborder Anisozygoptera, from which the true Anisoptera arose at the beginning of the Upper Jurassic. The Odonata as a whole reached their maximum percentage in the Upper Jurassic, and from then onwards they declined rapidly. Their percentage in the Tertiary was 1.6, in Recent times only 0.6.

Comparing the Odonata of the Ipswich Beds with those of the Liassic, we note that the percentage is distinctly less for Ipswich, viz., 3.3, as against 5.2 for the Lias (the latter will be greatly increased when the new species are taken into account). Not only so, but the forms discovered at Ipswich, though closely allied to some of the Liassic forms, are distinctly simpler in structure, and therefore more archaic. The genus *Triassolestes* from Ipswich has a petiolate wing-base without any signs of an anal area at all, and is the only known Odonate type, exclusive of the undescribed Lower Permian form, which possesses this exceedingly simple and archaic condition. As the evolution of the Order as a whole from exceedingly simple, petiolate types, of which our Australian genera *Hemiphlebia, Chorismagrion* and *Synlestes* are the nearest existing forms at the present day, has been clearly established, not only by the discovery in the Lower Permian of Kansas, but also by Dr. C. H. Kennedy's wonderful work on the penes of the males of Odonata, we may safely conclude that the Ipswich Odonate fauna belongs to a period not far from the Lias, but undoubtedly somewhat older. This evidence, then, would also point to an Upper Triassic age for the Ipswich Beds.

(4). *Evolution of the Trichoptera and Diptera.* In the Upper Permian of Belmont there occur two remarkable wings, *Belmontia** and *Parabelmontia*,† which I have shown to be allied to the true Mecoptera and almost certainly a portion of the original stock which gave origin to the three Orders Diptera, Trichoptera and Lepidoptera. *Belmontia,* which possesses the distal fork of Cu_1, indicates the condition of evolution at that time of the combined Trichoptero-Lepidopterous ancestral stock. *Parabelmontia,* which has a simple Cu_1, indicates the condition of the ancestors of the Diptera at that time. In the European Lias, no wings comparable to these two are to be found; but true Trichoptera appear in the Lower Lias, and true Diptera in the Upper Lias. Now if we turn to the Ipswich fauna, we find, on the one hand, no true Paramecoptera present, and on the other hand no true Trichoptera or Diptera present either. But there is present a group, which I have placed in a separate Order Paratrichoptera, in which the wings closely resemble those of archaic Trichoptera and Diptera, but differ from both of them in important points. They are not true Trichoptera, because they do not possess the apical fork of Cu_1, which all archaic Trichoptera possess. They are not true Diptera, because they have not yet undergone any reduction or narrowing-in of the basal part of the wing, and, therefore, by inference, they also still possessed well developed hindwings. These wings of the Order Paratrichoptera are, in fact, intermediate forms between the Upper Permian *Parabelmontia* and true Diptera. Hence we must conclude that the beds in which they are found lie between the Upper Lias, where true Diptera occur, and the Upper Permian, where *Parabelmontia* occurs. Also, since no true Trichoptera occur at Ipswich,

* These Proceedings, xliv., 1919, p. 234.
† These Proceedings, xlvii., 1922, p. 284.

and such were fairly abundant in the Lower Lias, it is a fair conclusion to come to that these beds are not Lower Lias, but somewhat older. The same result is obtained if we consider the time it would take, in the course of evolution, for the Paratrichoptera to lose their hindwings and become true Diptera. If these wings were Lower Liassic, we should at any rate expect to see some more definite evidence of reduction of the base of the forewing, indicating the actual beginnings of the true Order Diptera. Morphologically, the wings of the Paratrichoptera are almost as close to those of *Parabelmontia* as they are to the forewings of Diptera, and this fact requires that we should place them at least as far back as the Upper Trias.

(5). *Coleoptera.* The first known fossil Coleoptera are a few small elytra recently found at Belmont, but not yet described. These elytra are closely similar to the majority of the elytra found at Ipswich, and can be definitely assigned to the Hydrophilidae. The percentage of Coleoptera in the Lias was just about 42; and this Order, the dominant one amongst the Insecta, has kept this percentage almost unchanged to the present day. At Ipswich, the percentage was 47.6. A simple explanation of this record percentage is to be found if we look at the percentages of the other Holometabolous Orders at Ipswich. No Diptera or Trichoptera had yet appeared on the scene, and the Mecoptera and Planipennia were not yet as abundant as they were in the Lias. It has been the uprising of these groups and, later on, of the Hymenoptera and Lepidoptera, which has kept the percentage of Coleoptera stationary, in spite of the great actual numerical increase of species within the Order. Hence we find, at Ipswich, a period represented when the Coleoptera, as the first of the highly successful Holometabolous Orders (for the older Mecoptera and Planipennia never became highly successful), reached its maximum percentage compared with other Orders. Such a period must of necessity have been somewhat earlier than the Lias, while the great disparity between the percentages of Coleoptera at Belmont (10.5 per cent.) and Ipswich (47.6 per cent.) would indicate that it was considerably removed from the Upper Permian. The evidence, then, would lead us to assign an Upper Triassic age for the Ipswich Beds.

(6). *Hemiptera.* This Order offers very convincing evidence of the age of the Ipswich Beds. Hemiptera first appear in the Upper Permian, both in Europe and at Belmont, and are in both cases represented by only the single Suborder Homoptera. The Order was at its maximum percentage at Belmont, chiefly because no other groups were present in sufficient numbers to compete with it, except only the Mecoptera. From that time onwards its comparative percentage decreased to the end of the Mesozoic, rising again to 12.3 in the Tertiary, and finally falling to 7.9 at the present day. At the same time, the Suborder Heteroptera, which was absent in the Upper Permian, has gradually gained on the Suborder Homoptera, until at the present day it accounts for 4.5 of the 7.9 per cent. for the whole Order, leaving only 3.4 for the Suborder Homoptera. In the European Lias, the percentage of Hemiptera to the whole Insect fauna is 9.6, made up of 7.4 Homoptera and 2.2 Heteroptera. Thus it will be seen that, in the Lias, the Homoptera were more abundant than the Heteroptera in the proportion of about 7 to 2, though at the present day the Heteroptera are the more abundant. At Ipswich, the percentage of Hemiptera to the total Insect fauna is 27.9, which is intermediate between the percentage for Belmont (47.4) and that for the European Lias (9.6), and somewhat nearer the latter than the former. Also, if we compare the proportions of Homoptera to Heteroptera, we find 22.2 per cent. of the former to 5.7 per cent. of the latter, or a proportion of about 4 to 1, i.e., the

Homoptera are a little more abundant proportionately than in the Lias. Expressed as percentages of the whole Order Hemiptera, we have the following results:—

Suborder.	Belmont.	Ipswich.	European Lias.	Recent.
Homoptera	100.0	79.6	77.1	43.0
Heteroptera	0.0	20.4	22.9	57.0

We see again from this result that the evidence offered by the percentage and composition of the Order Hemiptera at Ipswich is to the effect that the age of the Ipswich Beds is intermediate between the Upper Permian of Belmont and the European Lias, and definitely closer to the latter than to the former.

On all the above six counts, then, we come to the same conclusion, viz., that the Ipswich Beds are definitely older than the Lias, but not very much older. The same results would have been obtained if we had considered the whole of the Order Orthoptera, since we should then note, not only the relative decrease in the Cockroaches as we pass from Ipswich to the Lias, but also the relative increases in the two newer Suborders Mantoidea and Locustoidea. As the first known Locustoid occurs in the passage beds between Upper Permian and Lower Trias in the Balmain Colliery at Sydney, N.S.W.,* the relative increase of the Suborder Locustoidea is particularly striking; this Suborder is outstandingly the dominant group of Orthoptera at the present day.

The presence at Ipswich of archaic Orders (Aeroplanoptera, Protorthoptera, Protomecoptera) not found in the Lias or any later beds, also leads us to the same conclusion.

Making all due allowance for the possibility of an Australian Mesozoic Insect fauna being somewhat more archaic in composition than a European fauna of the same time (but not much, for it is clear that the Upper Permian Insect fauna of Belmont was, if anything, ahead of contemporary faunas in other parts of the world), the following would appear to be a fair conclusion as to the age of the Ipswich Insect Beds:—

The composition of the Insect Fauna of the Ipswich Beds indicates, both collectively and by analysis of its outstanding groups, that *the age of the Beds was not earlier than the lowest division of the Upper Triassic, and not later than the top of the Upper Triassic; it was most probably a little older than Rhaetic.*.

**Elcanopsis sydne ensis* Till., These Proceedings, xliii., 1918, p. 263.

Appendix.

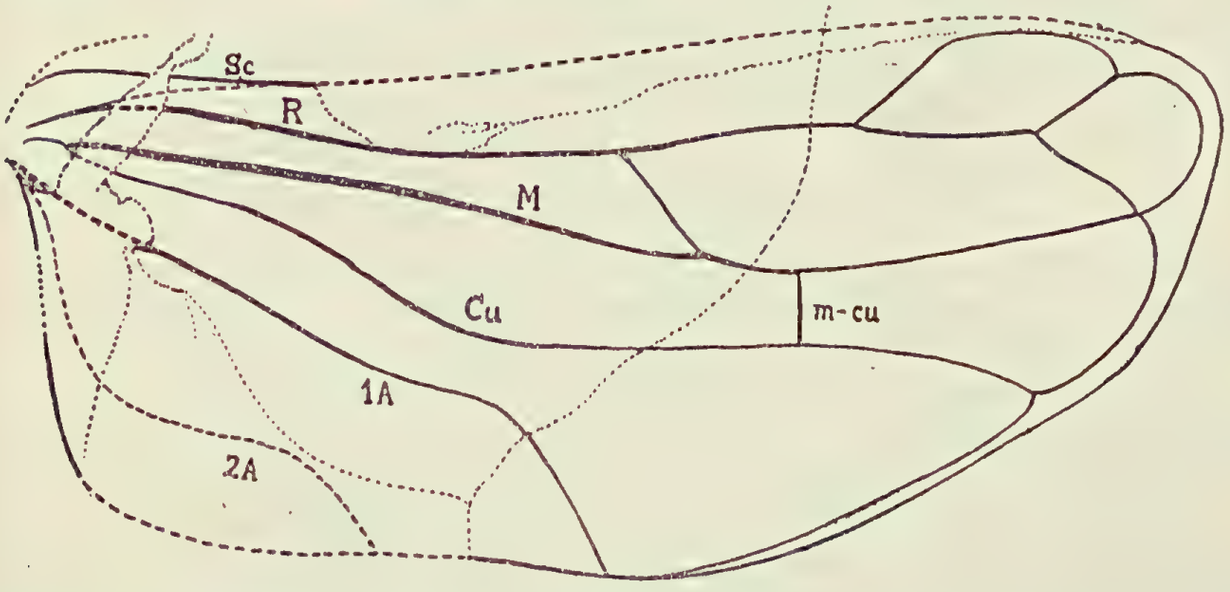
Order **HEMIPTERA.**

Suborder **Homoptera.**

Family IPSVICIIDAE.

IPSVICIA JONESI Till. (Plate xliii., fig. 38; Text-fig. 90).

Hindwing: *Total length* 10.5 mm.; *greatest breadth* 4.7 mm. A nearly complete impression, with most of the costal margin and about one-third of the posterior margin missing. Main veins stoutly built. R slightly waved, giving off at about half-way a descending oblique branch which meets M somewhat before the level of the medio-cubital cross-vein; further distad, R gives off an anterior oblique branch, and finally forks widely not far from apex; the ambient vein connects these last three branches of R in two loops, and continues posteriorly as a convex loop between the ends of M and Cu, and as a slightly convex loop between Cu and 1A; the ambient vein is throughout very close to the wing-margin. M nearly straight up to half-way, and then curving slightly upwards to meet the posterior distal fork of R at its apex. Medio-cubital cross-vein (*m-cu*) situated at about two-thirds. Cu considerably waved near middle concavely to costal border, unbranched. 1A a strong, simple vein strongly bent downwards in its distal third. 2A a shorter vein, strongly double-curved.



Text-fig. 90. *Ipsvicia jonesi* Till. Hindwing. (x 6.7). Missing portions restored by dotted lines. Drawing made from Specimens No. 285a and 340. 1A, 2A, first and second anal veins; Cu, cubitus; M, media; m-cu, medio-cubital cross-vein; R, radius; Sc, subcosta.

Heautotypes: Specimen No. 285*a* shows the hindwing as figured in Plate xliii., fig. 38 and Text-fig. 90; the whole of 2A as well as the dotted portions of the costal and posterior margins are missing in this specimen. Specimen No. 340*a* is an impression of all four wings of a large individual close together and partially overlying one another. A large portion of the base of one hindwing, lying clear of the tegmina, shows 2A and 1A complete, a considerable portion of M, and about the basal fourth of R and the costa; Sc can be seen as a short vein joining the costa not far from base. One tegmen is complete, measuring 13 mm. long; the other has only the apical portion preserved, and the second hindwing is folded under and between the two, so that only a small part of it can be seen.

This specimen affords the proof that the more complete hindwing represented by itself in Specimen No. 285 belongs to *Ipsvicia jonesi* Till.

Additional material of the tegmina of this species is found in Specimen No. 226, consisting of a complete tegmen, 13 mm. long, only moderately well preserved, together with a small fragment of the base of a second tegmen lying close beside it; 17 mm. away from these, on the same piece of rock, lies another almost complete tegmen, moderately well preserved. All the above are in Coll. Queensland Geol. Survey, Brisbane, Q.

Horizon.—Upper Triassic, Ipswich, Q.

The discovery of the hindwing of the genus *Ipsvicia* is of great interest, because of the simplicity of the venation, in which M is unbranched, and the primitive condition of the ambient vein, lying very close to the border of the wing. These characters can now be added to the definition of the family Ipsviciidae, which would appear to be well established on the combined characters of the tegmen and hindwing.

Suborder **Heteroptera.**

Family TRIASSOCORIDAE.

Triassocoris myersi Tillyard.

Specimen No. 150*a-b* appears to represent the body of this species, with the exception of the head and pronotum, which are missing. The scutellum is broad and triangular; the shape of the body broadly oval. There are signs of the segmentation of the first two abdominal segments only. *Total length* of specimen, 5.1 mm., *greatest breadth* 4.4 mm.

Triassocoris scutulum Tillyard.

Specimen No. 179*a-b* appears to represent the body of this species, with the exception of the head and pronotum, which are missing. The scutellum is subtriangular, less wide than in *T. myersi;* the shape of the abdomen is somewhat narrower, and somewhat pointed apically. *Total length* of specimen, 5 mm., *greatest breadth* 3 mm.

Triassocoris ovalis, n.sp. (Text-fig. 91).

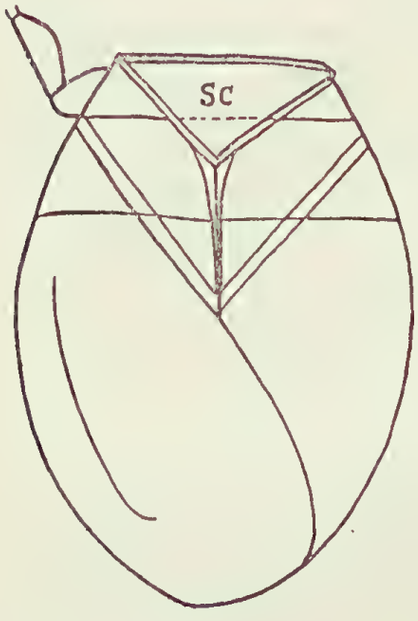
This is also an impression of the whole body with the exception of head and pronotum; in addition, the hemelytra can be faintly made out. The scutellum is triangular, not so wide as in *T. myersi;* the abdomen is broadly oval, even more rounded apically than in *T. myersi;* the hemelytra appear to be slightly granulose and also slightly and delicately striated distally. There is also what appears to be an impression of portion of the left fore-leg. *Total length* of specimen, 4.8 mm., *greatest breadth* 3.6 mm.

Type, Specimen No. 129*a,* in Coll. Queensland Geol. Survey, Brisbane.

Horizon.—Upper Triassic, Ipswich, Q.

TRIASSOCORIS GRANDIS, n.sp. (Text-fig. 92).

This specimen shows the same parts of the body as the three preceding, but is considerably larger; it is remarkable in that the wings were either missing or too faintly impressed to be made out with certainty, whereas on the other hand the segmentation of the abdomen is clearly marked, so that it can be seen that the



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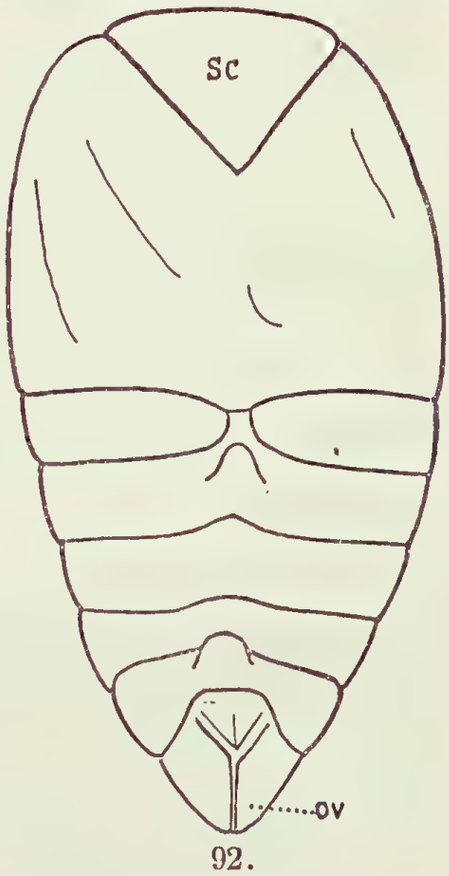

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Text-fig. 91. *Triassocoris ovalis*, n.sp. Body with hemelytra and part of left foreleg. (x 6.7). Drawn from Specimen No. 129a. sc, scutellum.
Text-fig. 92. *Triassocoris (?) grandis*, n.sp. Body (x 6.7). Drawn from Specimen No. 196a. ov, ovipositor; sc, scutellum.

specimen was a female. The scutellum is sub-triangular, rather small for the size of the insect, and comparatively narrow. In the abdomen, which is sub-triangular and well pointed apically, six segments can be clearly made out, together with a terminal ovipositor. *Total length* of specimen 7.3 mm., *greatest breadth* 3.9 mm.

Type, Specimen No. 196*a* in Coll. Queensland Geol. Survey.

Horizon.—Upper Triassic, Ipswich, Q.

Order **NEUROPTERA.**

Suborder **Planipennia.**

Family PROHEMEROBIIDAE.

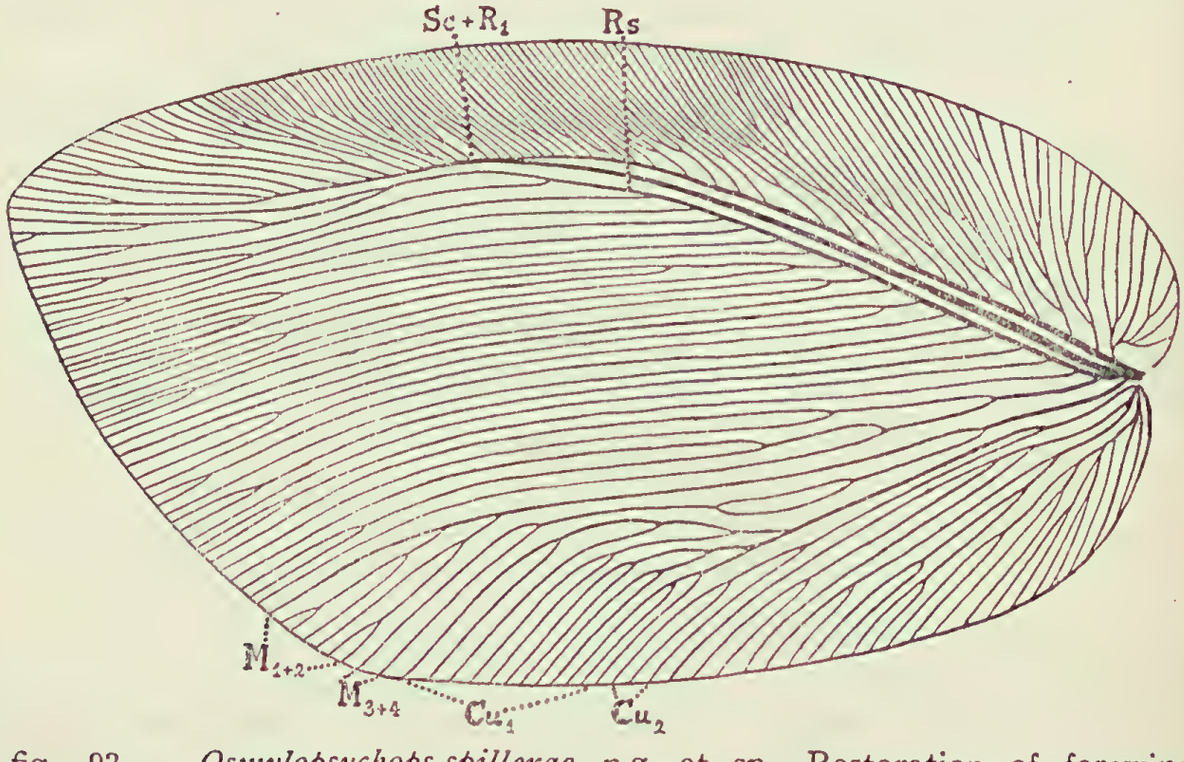
This family is characterised by a general similarity to the recent Psychopsidae, but is less specialised in lacking the strong *vena triplica* formation found in that family, and in having the wings less rounded apically, with the costal space not so broadly expanded. A single genus and species, *Protopsychopsis venosa* Till., has already been described from Ipswich.

Genus Osmylopsychops, n.g. (Plate xliii., figs. 39, 40; Text-fig. 93).

Costal area of moderate breadth basally, diminishing towards apex. Costal veinlets arising from Sc close to base at an angle of about 45°, but this angle rapidly diminishes further from the base, and for most of the wing-length is about 25° to 20°; these veinlets very numerous and close together, many of them forked, but there are no clear signs of any connecting cross-bars. Sc straight for most of its length, then arching somewhat downwards and fusing at a slight angle with R_1 (as in recent Osmylidae). R_1 a strong vein, straight for most of its length, but somewhat curved downwards after fusing with Sc. Rs running close below R_1, but neither fused nor connected with it in any manner. Branches of Rs numerous, about twenty, closely parallel, some forked near bases, most of them with small distal forks. These sectors arise from Rs at an angle varying from 35° to 30° only. M forked near base, the two branches running closely parallel to one another and to the branches of Rs just above them. Cu forked near base, Cu_2 running close below Cu_1 for most of its length; some little way from the posterior border of the wing, Cu_1 arches away from Cu_2 and branches into several forked veins which occupy the triangular space between M_{3+4} and Cu_2. Anal veins with numerous branches.

Genotype, *Osmylopsychops spillerae*, n.sp. (Upper Trias of Ipswich, Q.).

This genus is undoubtedly a true Prohemerobiid on account of the general structure of the venation and the primitive condition of the three veins Sc, R_1 and Rs, which do not form a true *vena triplica;* but it is remarkable in having Sc fused with R_1 in the manner of recent Osmylidae. This character is indicated in the generic name. The distal branching of Cu_1 is also peculiar and indicates, perhaps, some connection with the Berothidae. The small angle at which the branches of Rs arise is also noteworthy, and will serve to distinguish this genus at a glance from the other Triassic Planipennia.



Text-fig. 93. *Osmylopsychops spillerae*, n.g. et sp. Restoration of forewing (x 2.5). Cu_1, Cu_2, first and second branches of cubitus; M_{1+2}, M_{3+4} branches of media; Rs, radial sector; $Sc+R_1$, fused subcosta and radius.

OSMYLOPSYCHOPS SPILLERAE, n.sp. (Plate xliii., figs. 39, 40; Text-fig. 93).

This species is represented by two fairly large wing-fragments; both prc bably belong to the forewing, but not to the same individual.

Specimen No. 314a has a total length of 14 mm., and shows most of the basa portion (the costal and posterior margins indistinct), with a distance of about mm. along the three main veins Sc, R_1 and Rs. Beyond this there is a gap; but below that gap, a series of no less than thirteen sectors of Rs are preserved com pletely to the somewhat broken wing-margin; below these again are the complet M and Cu and basally, all except the extreme bases of the anal veins are pre served. A noteworthy feature of M_{3+4} is the presence of an elongate oval close cell about the middle of its length; this cell indicates the division and re-fusion o M_3 and M_4, and is to be found in a number of recent Psychopsidae. It is mos probably a specific character, but may have been only an individual one. Th apical expansion and forkings of Cu_1 are well shown in this specimen.

Specimen No. 283a has a length of 12.5 mm. and shows a large portion of th wing with the exception of the basal third, the extreme apical piece, and th margins of the wing; there is also a large gap in the distal portions of a numbe of the branches of Rs. The distal forkings of Cu_1, and the course of Cu_2 in deep furrow just below it, are absent except for a small portion; but this portio is just sufficient to allow of this fragment being placed in position upon the pre vious fragment, when it will be seen that the two practically coincide with respec to every vein common to the two, so that they evidently belong to the sam species. This fragment shows very clearly the fusion of Sc with R_1, and th manner in which Rs remains unconnected with R_1 throughout, though running closely below it.

Type, Specimens No. 314*a* (holotype) and No. 283*a* (heautotype) in Coll Queensland Geol. Survey, Brisbane.

Horizon.—Upper Triassic of Ipswich, Q.

The species is dedicated to Miss S. M. Spiller, of the Geological Survey Brisbane. The complete forewing is shown restored in Text-fig. 93.

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———, 1918*a*.—Permian and Triassic Insects from New South Wales in the Collection of Mr. John Mitchell. *Id.,* xlii., pt. 4, pp. 720 756.

———————, 1918*b*.—Mesozoic Insects of Queensland. No. 3. Odonata and Protodonata. *Id.*, xliii., pt. 3, pp. 417-436.

———————, 1918*c*.———————————. No. 4. Hemiptera Heteroptera: the Family Dunstaniidae. With a Note on the Origin of the Heteroptera. *Id.*, xliii., pt. 3, pp. 568-592.

———————, 1919*a*.———————————. No. 5. Mecoptera, the new Order Paratrichoptera, and additions to Planipennia. *Id.*, xliv., pt. 1, pp. 194-212.

———————, 1919*b*.———————————. No. 6. Blattoidea. *Id.*, xliv., pt. 2, pp. 358-382.

———————, 1920.———————————. No. 7. Hemiptera Homoptera; with a Note on the Phylogeny of the Suborder. *Id.*, xliv., pt. 4, (1920), pp. 857-896.

———————, 1921.———————————. No. 8. Hemiptera Homoptera (contd.). The Genus *Mesogereon;* with a Discussion of its Relationship with the Jurassic Palaeontinidae. *Id.*, xlvi., pt. 2, pp. 270-284.

———————, 1922.—Mesozoic Insects of Queensland. No. 9. Orthoptera, and Additions to the Protorthoptera, Odonata, Hemiptera and Planipennia. *Id.*, xlvii., pt. 4, pp. 447-470.

EXPLANATION OF PLATE XLIII.

'ig. 38. *Ipsvicia jonesi* Till. Hindwing. (x 6½). Specimen No. 285a.
ig. 39. *Osmylopsychops spillerae*, n.g. et sp. Fragment of wing. (x 5.6). Specimen No. 314a. Holotype.
'ig. 40. *Osmylopsychops spillerae*, n.g. et sp. (x 6). Specimen No. 283a. Heautotype.

Corrigendum.

On page 482 insert the heading, *Sub-order Zygoptera.*, above Family Triassolestidae (line 12).

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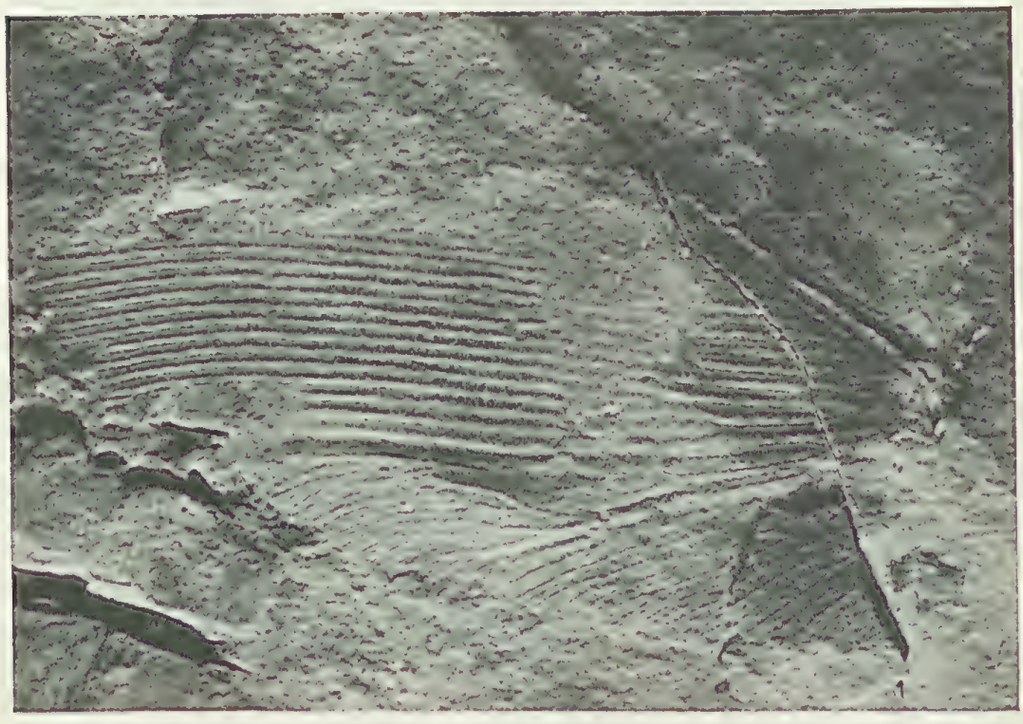

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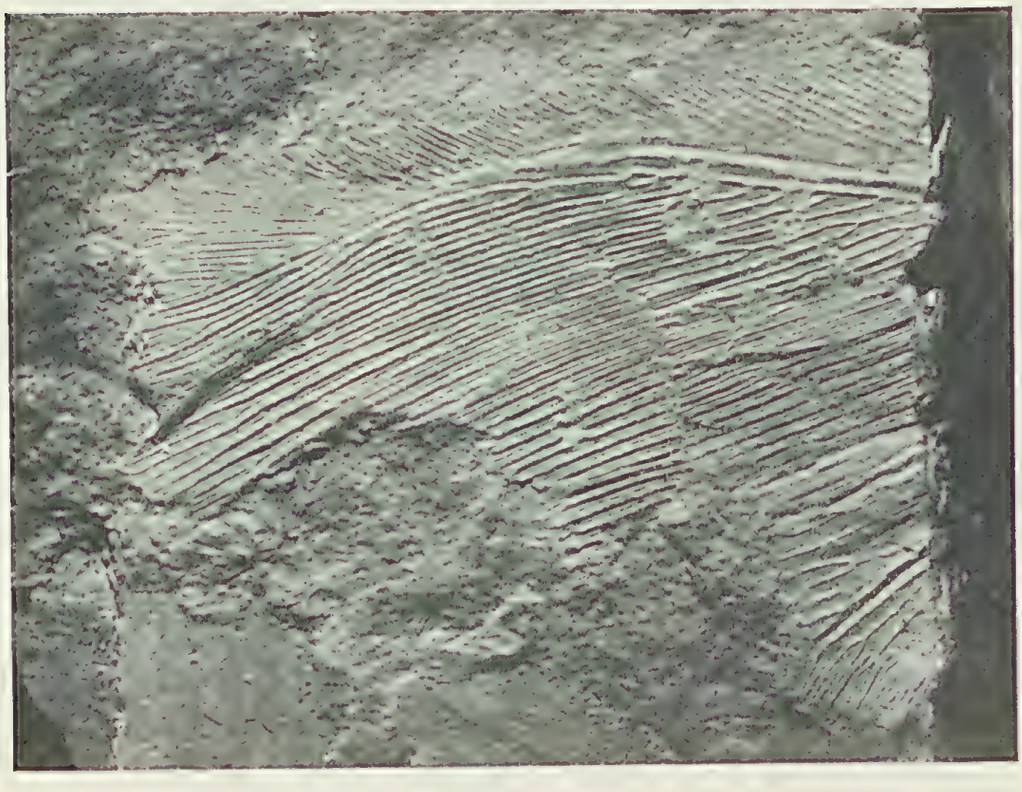

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38. *Ipsvicia jonesi*. 39-40. *Osmylopsychops spillerae*.

NATIONAL MUSEUM
VICTORIA

CONCLUDING NOTE.

By B. Dunstan.

Now that Dr. Tillyard has completed the task of describing the wonderful collection of fossil insects from Denmark Hill, the description of which forms Part 2 of this Bulletin, and which is a reprint from the Proceedings of the Linnean Society of New South Wales, there remains the very pleasant duty of placing on record our indebtedness to him for his great task.

The discovery of these insects some years ago was quite unheeded by entomologists, and their significance was much discounted, and it was only when Dr. Tillyard took the matter in hand that their great scientific value was realized. Probably they would still be unnoticed were it not for the interest Dr. Tillyard took in their examination and description. We would esteem it a great favour if he, later on, examined the material we are now accumulating as a supplementary collection, but hesitate to approach him in view of the large amount of work he has already accomplished for us, and because of the many important entomological investigations engaging his attention at the present time.

The results of the examination of the fossil remains have warranted the trouble spent in collecting and describing them, not only in showing the varied forms of insect life then existing and their subsequent changes through the ages, but also in enabling an entomologist to express an opinion on the geological age of the beds in which they were found, irrespective of other palæontological factors. This is a matter of some moment in the general controversy regarding the age of the coal-bearing Ipswich Formation, which can now, after Dr. Tillyard's sound reasoning, be placed in the upper portion of the Triassic System.

Additional fossil-bearing material is examined as opportunities present themselves, and perhaps 20 per cent. of all that was possible to excavate has yet to be operated upon. The system of working, as described in Part 1, is to mark on a working plan the positions of all the material removed from the quarry, and as picked portions of this are examined the results are also marked on the plan. It is found that the regularity of the occurrence of the fossils is such that the number of specimens in any

particular position can now be closely estimated, from which the deduction is made that the most prolific portions are in small patches, apparently circular, and that from these rich centres the material gradually becomes impoverished in all directions. Therefore, before a box of fossil-containing shale is split up, one can estimate, perhaps to within 10 per cent., the number of specimens which will be recovered with due care and attention. This working plan is very useful, but a natural tendency exists to work on the portions estimated to be richest, leaving the poorer material to the last.

In Table A, on page 487 (223), Dr. Tillyard shows the numerical composition of the insect fauna, the estimate being based on the number of *species* described. In the following Table C. the composition is based on the number of *specimens* obtained of each species, and would therefore have a different value. From this Table it will be seen that the most important order is the Coleoptera, the number found representing 50 per cent. of all the specimens, next in importance being the Homoptera (15 per cent.) and Blattoidea (13 per cent.).

Amongst the individual genera, *Ademosyne* is the most conspicuous, 17 per cent. of all the specimens belonging to it, *Ademosynoides* (6·5 per cent.) and Samaroblatta (5·7 per cent.) being next in abundance. Amongst the species, *Mesorthopteron locustoides* is by far the most abundant form, as it represents 5 per cent. of all the specimens obtained. Several other species are also abundant, including *Ademosyne australiensis*, *A. congener*, *A. major*, *Ademosynoides angusta*, and *Ipsvicia Jonesi*, all representing 3 per cent. of the total number.

The Table of flora percentages, Part 1, page 5, shows that about 75 per cent. of the flora is made up of ferns, the remainder consisting of ginkgos and cycads, while the presence of fossil woods shows that conifers are also present. The tabulated results, therefore, in showing the names and percentages of both floral and faunal specimens, give a very good impression of the variety and abundance of the life forms in this period.

TABLE C.

SHOWING RELATIVE ABUNDANCE OF INSECT FAUNA.

Order Percentages.

Order.	Per Cent.	Order.	Per Cent.
Coleoptera	50·0	Mecoptera	1·2
Homoptera	15·0	Neuroptera	0·6
Blattoidea	13·0	Protomecoptera	0·3
Heteroptera	6·0	Prodonata	0·2
Prothorthoptera	5·2		100·0
Paratrichoptera	4·0		
Orthoptera	2·0		
Odonata	2·5		

Genera Percentages.

Genera.	Per Cent.	Genera.	Per Cent.
Ademosyne	17·0	Tryoniopsis	1·5
Ademosynoides	6·5	Ipsviciopsis	1·5
Samaroblatta	5·7	Simmondsia	1·1
Triassocoris	5·0	Tillyardiopsis	1·1
Mesorthoptera	5·0	Triassojassus	1·0
Apheloodes	4·1	Polysitum	1·0
Ipsvicia	4·0	Austroblattula	1·0
Mesothoris	3·3	Leioodes	1·0
Reeveana	2·6	Lobites	1·0
Mesojassus	2·5	Genera less than 1 per cent. total	26·1
Mesocixiodes	2·0		100·0
Mesodiphthera	1·5		
Mesogereon	1·5		
Aristopsyche	1·5		
Triassoblatta	1·5		

Species Percentages.

Species.	Per Cent.	Species.	Per Cent.
Mesothopteron locustoides	5	Samaroblatta reticulata ..	2
Ademosyne australiensis	3	Triassocoris Myersi ..	2
Ademosyne congener ..	3	Ademosyne Olliffi ..	1
Ademosyne major ..	3	Austroblattula ipsviciensis	1
Ademosynoides angusta ..	3	Ipsviciopsis elegans ..	1
Apheloodes obliqua ..	3	Mesocixiodes orthoclada ..	1
Ipsvicia Jonesi	3	Mesothoris grandis ..	1
Ademosyne intermedia ..	2	Simmondsia subpyriformis	1
Ademosynoides striatella	2	Species less than 1 per cent. total	53
Apheloodes rugosa ..	2		100
Aristopsyche superba ..	2		
Mesojassus ipsviciensis ..	2		
Reeveana minor	2		
Samaroblatta Jonesi ..	2		

INDEX TO GENERA AND SPECIES.

Parts 1 and 2.

Genera and Species.	Parts.	Pages (bottom).	Pages (top).	Text Figures.	Plate Figures.	
					Figures.	Plates.
Ademosyne, *Handlirsch*	1	..	11	..	..	..
,, adunca, *Dunst.* ..	1	..	23	..	14	2
,, australiensis, *Till.* ..	1	..	19	..	3	1
,, brevis, *Dunst.*	1	..	17	..	6	1
,, Cameroni, *Till.* ..	1	..	24	..	11	2
,, congener, *Till.* ..	1	..	22	..	16	2
,, curvata, Dunst. ..	1	..	18	..	7	1
,, intermedia, *Dunst.* ..	1	..	14	..	2	1
,, lata, *Dunst.*	1	..	15	..	5	1
,, major, *Handl.*	1	..	15	..	1, 12	1, 2
,, Olliffi, *Handl.*	1	..	12	..	9	1
,, parva, *Dunst.*	1	..	13	..	8	1
,, punctata, *Till.*	1	..	23	..	15	2
,, ramocostata, *Dunst.* ..	1	..	19	..	4	1
,, rugulosa, *Dunst.* ..	1	..	20	..	10	1
,, vittamargina, *Dunst.* ..	1	..	21	..	13	2
Ademosynoides, *Dunstan*	1	..	25	..	..	..
,, abnormis, *Dunst.* ..	1	..	30	..	23	3
,, alternata, *Dunst.* ..	1	..	27	..	19	2
,, angusta, *Till.* ..	1	..	29	..	20	3
,, magnifica, *Dunst.* ..	1	..	31	..	27, 28	3
,, minor (*Handl.*) ..	1	..	26	..	18	2
,, obtusa (*Till.*) ..	1	..	26	..	17	2
,, striatella, *Dunst.* ..	1	..	28	..	26	3
Aeroplana mirabilis, *Tillyard* ..	2	54	426	14, 15, 16*b*	12–14	44, 45
Aeschnidiopsis flindersiensis (*Woodward*)	2	27	675	8, 9, 10	9, 10, 11	42, 43
Apheloodes *Dunstan*	1	..	70	..	..	..
,, obliqua, *Dunst.*	1	..	72	..	54	6
,, rugosa, *Dunst.*	1	..	71	..	55	6
Apheloscyta, *Tillyard*	2	204	458	..	..	..
,, mesocampta, *Till.* ..	2	205	459	78	33	53
Archepsychops, *Tillyard*	2	103	205	..	..	..
,, triassica, *Till.* ..	2	104	206	27	..	..
Archipanorpa, *Tillyard*	2	17, 110	191, 212	..	..	..
,, magnifica, *Till.* ..	2	17	191	6	4–8 16 (9), 17 (10)	8, 9, 67
Aristopsyche, *Tillyard*	2	98	200	..	..	..
,, superba, *Till.* ..	2	100	202	25	..	..
Austroblattula, *Tillyard*	2	134	380	..	..	..
,, ipsviciensis, *Till.* ..	2	135	381	39	..	..
Blattoidea *Incertæ sedis*	2	135	381	40	..	..
Chiliocycla, *Tillyard*	2	148	868	..	..	..
,, scolopoides, *Till.* ..	2	148; 206	869, 460	42 (2), 79	..	..
Dunstania pulcra, *Till.*	2	76	578	19	15	59
Dunstaniopsis, *Tillyard*	2	82	584	..	..	..
,, triassica, *Till.* ..	2	83	585	18	..	..
Elateridium, *Tillyard*	1	..	44	..	..	..
,, subulatum, *Dunst.* ..	1	..	44	..	31	4
,, transversum, *Dunst.* ..	1	..	45	..	30	4
Elaterium, *Westwood*	1	..	46	..	..	..
,, bipunctatum, *Dunst.* ..	1	..	47	..	46	5
,, punctomarginum, *Dunst.*	1	..	46	..	43	5
Etheridgiopsis australis, *Handl.* ..	1	..	68	..	60	7

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Genera and Species.	Parts.	Pages (bottom).	Pages (top).	Text Figures.	Plate Figures.	
					Figures.	Plates.
Eurymelidium, *Tillyard*	2	164	884	..	..	..
,, australe, *Till.* ..	2	165	885	56 (16)	..	..
Grammositus, *Dunstan*	1	..	37	..	..	..
,, bilineatus, *Dunst.* ..	1	..	38	..	35	4
Ipsvicia acutipennis, *Till.*	2	163	883	55 (15)	..	..
,, Jonesi, *Till.*	2	159, 229	879, 496	53 (13), 90	38	43
,, maculata, *Till.*	2	161	881	54 (14)	..	..
Ipsviciopsis, *Tillyard*	2	210	464	..	..	..
,, elegans, *Till.*	2	210	464	85	35	53
,, magna, *Till.*	2	211	465	86	..	..
Leioodes, *Dunstan*	1	..	68	..	..	..
,, plana, *Dunst.*	1	..	69	..	52	6
,, pygmæa, *Dunst.*	1	..	69	..	53	6
Lobites, *Dunstan*	1	..	53	..	..	..
,, granulatus, *Dunst.*	1	..	55	..	40	5
,, trivittatus, *Dunst.*	1	..	53	..	44	5
,, tuberculatus, *Dunst.* ..	1	..	54	..	41	5
Mecopteron. *Incertæ sedis*	2	96	198	24	..	..
Mesocixiodes, *Tillyard*	2	208	462	..	..	..
,, brachyclada, *Till.* ..	2	209	463	84	..	..
,, orthoclada, *Till.* ..	2	209	463	83	..	..
,, termioneura, *Till.* ..	2	208	462	82	34	53
Mesocixius triassicus, *Till.*	2	157	877	51 (11)	..	..
Mesodiphthera, *Tillyard*	2	153	873	..	..	..
,, Dunstani, *Till.* ..	2	208	462	81	..	..
,, grandis, *Till.* ..	2	153	873	47 (7)	..	..
,, prosboloides, *Till.* ..	2	207	461	80	..	..
Mesogereon, *Tillyard*	2	180	272	..	..	..
,, affine, *Till.*	2	185	277	69, 70	21, 22	19, 20
,, compressum, *Till.* ..	2	185	277	68	..	..
,, neuropunctatum, *Till.* ..	2	181	273	65	24	21
,, Shepherdi, *Till.* ..	2	187	279	71	23, 25	20, 21
,, superbum, *Till.* ..	2	182	274	66, 67	18, 20	16, 17, 18
Mesojassus, *Tillyard*	2	165	885	..	..	..
,, ipsviciensis, *Till.* ..	2	166	886	57 (17)	..	..
Mesophlebia, *Tillyard*	2	198	452	..	..	..
,, antinodalis, *Till.* ..	2	198	452	75	30	52
Mesopsyche, *Tillyard*	2	7	181	..	..	..
,, triareolata, *Till.* ..	2	8	182	2	1	7
Mesorthopteron locustoides, *Till.* ..	2	193	447	72	51	26
Mesoscytina, *Tillyard*	2	151	871	..	..	..
,, affinis, *Till.*	2	152	872	46 (6)	..	..
,, australis, *Till.* ..	2	151	871	45 (5)	..	..
Mesostigmodera typica, *Eth. & Olliff*	1	..	56	..	39	5
Mesothoris, *Tillyard*	1	..	58	..	..	..
,, clathrata (Till.) ..	1	..	59	..	51	6
,, grandis, *Dunst.* ..	1	..	61	..	48	6
,, quadripartita, *Dunst.* ..	1	..	60	..	50	6
,, tenuiclathrata, *Dunst.* ..	1	..	61	..	49	6
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,, elongata, *Till.* ..	2	102	204	36	..	..
Osmylopsychops Spilleræ, *Till.* ..	2	232	496	93	30, 40	43

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					Figures.	Plates.
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Paradunstania, *Tillyard*	2	83	585	..	..	..
,, affinis, *Till.*	2	84	586	20	..	..
Perissophlebia, *Tillyard*	2	50	422	..	..	..
,, multiseriata, *Till.*	2	52	424	13	..	..
Platycrossos, *Dunstan*	1	..	32	..	..	..
,, ligulatus *Dunst.* ..	1	..	33	..	22	3
,, subtumidus, *Dunst.* ..	1	..	34	..	24	3
,, tumidus *Till.*	1	..	34	..	21	3
Polysitum, *Dunstan*	1	..	40	..	..	..
,, minutum *Dunst.* ..	1	..	42	..	59	7
,, punctatum *Dunst.* ..	1	..	40	..	36, 37	4
Polycytella, *Tillyard*	2	206	460	..	..	..
,, triassica *Till.*	2	206	460	..	36	53
Protopsychopsis, *Till.*	2	4	178	..	..	..
,, venosa, *Till.* ..	2	6	180	1*a*	3	8
Reeveana, *Dunstan*	1	..	48	..	..	..
,, intermedia, *Dunst.* ..	1	..	49	..	45	5
,, major, *Dunst.*	1	..	48	..	38	5
,, minor, *Dunst*	1	..	50	..	42	5
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,, blattelloides, *Till.* ..	2	131	377	37	..	..
,, intercalata, *Till.* ..	2	133	379	38	..	..
,, Jonesi, *Till.* ..	2	130	376	36	..	..
,, reticulata, *Till.* ..	2	128	374	30*b*, 34	..	..
,, triassica, *Till.* ..	2	129	375	35	..	..
Shepherdia, *Dunstan*	1	..	38	..	..	..
,, quadrivittata, *Dunst.* ..	1	..	39	..	32	4
Simmondsia, *Dunstan*	1	..	35	..	..	..
,, cylindrica, *Dunst.* ..	1	..	37	..	29	4
,, subpyriformis, *Dunst.*	1	..	36	..	34	4
Stereochorista frustrata, *Till.* ..	2	95	197	23	..	..
Tillyardiopsis, *Dunstan*	1	..	64	..	..	..
,, granulata, *Dunst.* ..	1	..	66	..	56	7
,, tuberculata, *Dunst.* ..	1	..	65	..	57	7
,, variotubercula, *Dunst.*	1	..	67	..	58	7
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,, australiense, *Till.* ..	2	202	456	77	31	52
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,, insignita, *Till.* ..	2	124	370	32	..	..
,, intermedia, *Till.* ..	2	125	371	33	..	..
,, typica, *Till.* ..	2	122	368	30*a*, 31	..	..
Triassocixius, *Tillyard*	2	158	878	..	..	..
,, australis, *Till.* ..	2	158	878	52 (12)	..	..
Triassocoris, *Tillyard*	2	212	466	..	..	..
,, grandis, *Till.*	2	231	495	92	..	..
,, Myersi, *Till.*	2	212, 230	466, 494	..	..	..
,, ovalis, *Till.*	2	231	495	92	..	..
,, scutulum, *Till.* ..	2	213, 230	467, 494	..	..	..
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,, proavitus, *Till.* ..	2	168	888	58 (18)	..	..
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,, epiophlebioides, *Till.* ..	2	47	419	11, 12*b*	..	..

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					Figures.	Plates
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„ leptoptera, *Till.* ..	2	197	451	74	28	51
Triassomantis, *Tillyard*	2	196	450	..	..	..
„ pygmæus, *Till.* ..	2	196	450	73	27	51
Triassopsyche, *Tillyard*	2	8	182	..	..	..
„ Dunstani, *Till.* ..	2	10	184	3	2	7
Triassopsychops, *Tillyard*	2	213	467	..	..	..
„ superba, *Till.* ..	2	215	468	89	32	52
Triassoscarta, *Tillyard*	2	154	874	..	..	..
„ subcostalis, *Till.* ..	2	154	874	48 (8)	..	..
Tryoniopsis, *Dunstan*	1	..	51	..	..	..
„ granulata, *Dunst.* ..	1	..	52	..	59	7
„ punctata, *Dunst.* ..	1	..	51	..	65	7
Ulomites, *Tillyard*	1	..	42	..	..	..
„ Willcoxi, *Till.*	1	..	43	..	33	4
Unnamed Claval Areas	2	169	889	59-63 (19-23)	..	..
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„ magnopunctata, *Dunst.* ..	1	..	63	..	47	6

CORRIGENDA.

Part 1.

Pages.	
1	Ninth line, *for* 1908 *read* 1890.
23, 73	Delete *Ademosynoides attentuata.*
1, 45	For *Etheridgea* read *Etheridgiopsis.*
68	For *Etheridgea* read *Etheridgiopsis* (Handlirsch).
88	For *Etheridgea australis* read *Etheridgiopsis australis* (Handlirsch).
32, 40, 42, 56, 73, 82 ..	For *punctatus* read *punctatum.*
35, 36, 37, 73, 82 ..	For *sub-piriformis* read *subpyriformis.*
37, 38, 45, 73, 82 ..	For *Grammositum* read *Grammositus.*
41, 42, 73, 80	For *minutus* read *minutum.*
44, 45, 46, 64, 75, 82	For *Elaterites* read *Elateridium.*
44	For *Heer* read *Tillyard.*
44, 46, 75, 82	For *subulatus* read *subulatum.*
44, 45, 75, 82	For *transversus* read *transversum.*
42, 68, 69, 72, 75, 86 ..	For *planum* read *plana.*
68, 69, 70, 75, 86 ..	For *pygmaeum* read *pygmaea.*
70, 71, 72, 75, 86 ..	For *rugosum* read *rugosa.*
70, 71, 72, 75, 86 ..	For *obliquum* read *obliqua.*
73	For Fig. 59 Pl. 7 (2nd and 3rd columns) *read* Fig. 25 Pl. 3.

Part 2.

Pages 175 (Linn. Soc. Page) to 200, 675 to 685, and 447 to 470 should be numbered at the bottom 1 to 26, 27 to 44, and 193 to 216 respectively.
Page 17 next to Plate IX. *add* Text fig. 6.
Page 26 (200) Plate IV. *read* Plate IX.
Page 26 (opposite to) on Plate IX. *add* Figs. 7, 8.
Page 90 (opposite to) on Plate LIX. *add* Fig. 15.
Page 110 (opposite to) on Plate LXVII. *for* 9, 10, read 16, 17.
Page 127 (373) for *S. blabelloides* read *S. blattelloides.*
Pages 131-2 (377-8) *for* Blabelloides *read* blattelloides.
Page 132 (378) for *Blabella* read *Blattella.*
Page 135 (381) *for* Text-fig.—38 top line *read* 39, for *blabelloides* read *blattelloides.*
Pages 140-1 (860-1) *for* Text-fig. 1 *read* 41.
Page 142 (862) *for* Text-fig. 1*b*, 1*c* *read* 41*b*, 41*c*.
Page 143 (863) *for* Text-fig. 4 *read* 44.
Page 145 (865) for *Willcoxiidae* read *Ipsviciidae.*
Pages 148-9 (868-9) *for* Text-fig. 2, 3 *read* 42, 43.
Pages 150-2 (870-2) *for* Text-fig. 3, 4, 5, 6 *read* 43, 44, 45, 46.
Pages 153-5 (873-5) *for* Text-fig. 6, 7, 8, 9 *read* 46, 47, 48, 49.
Pages 156-7 (876-7) *for* Text-fig. 10, 11, 12 *read* 50, 51, 52.
Pages 158-9 (878-9) *for* Text-fig. 12, 13, 15 *read* 52, 53, 55.
Pages 160-2 (880-2) *for* Text-fig. 13, 14, 15 *read* 53, 54, 55.
Pages 163-4 (883-4) *for* Text-fig. 15, 16 *read* 55, 56.
Pages 165-8 (885-8) *for* Text-fig. 1*c*, 16, 17, 18 *read* 41*c*, 56, 57, 58.
Page 169 (889) *for* Text-fig. 19, 20 *read* 59, 60.
Pages 170-5 (890-5) *for* Text-fig. 20, 21, 22, 23, 24 *read* 60, 61, 62, 63, 64.
Page 218 (482) below line 11 *insert* "Sub-Order *Zygoptera.*"
Page 4 (178) line 11 *for* Plate VII. *read* VIII.
Page 8 (182) line 8 *for* Plate VIII. *read* VII.
Page 27 (675) place [aeschna] *after* Woodward.

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